CBSE Class–12 Mathematics

NCERT solution

Chapter - 4

Determinants - Exercise 4.6

Examine the consistency of the system of equations in Exercises 1 to 3.

1. $x+2y=2;\quad 2x+3y=3$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix}1 & 2\\ 2 & 3\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}2\\ 3\end{bmatrix}$$

$\therefore$ A = $\begin{bmatrix}1 & 2\\ 2 & 3\end{bmatrix}$ and B = $\begin{bmatrix}2\\ 3\end{bmatrix}$

$\therefore |A|=\begin{vmatrix}1 & 2\\ 2 & 3\end{vmatrix} = 3-4=-1\neq 0$

Therefore, Unique solution and hence equations are consistent.

2. $2x-y=5;\quad x+y=4$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix}2 & -1\\ 1 & 1\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}5\\ 4\end{bmatrix}$$

$\therefore$ A = $\begin{bmatrix}2 & -1\\ 1 & 1\end{bmatrix}$ and B = $\begin{bmatrix}5\\ 4\end{bmatrix}$

$\therefore |A|=\begin{vmatrix}2 & -1\\ 1 & 1\end{vmatrix} = 2-(-1)=3\neq 0$

Therefore, Unique solution and hence equations are consistent.

3. $x + 3y = 5$
$2x + 6y = 8$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 1 & 3 \\ 2 & 6 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 8 \end{bmatrix}$$

$\therefore$ A = $\begin{bmatrix} 1 & 3 \\ 2 & 6 \end{bmatrix}$ and B = $\begin{bmatrix} 5 \\ 8 \end{bmatrix}$

$\therefore$ $|A| = \begin{vmatrix} 1 & 3 \\ 2 & 6 \end{vmatrix}$ = 6 – 6 = 0

Now (adj. A) B = $\begin{bmatrix} 6 & -3 \\ -2 & 1 \end{bmatrix}\begin{bmatrix} 5 \\ 8 \end{bmatrix}$ = $\begin{bmatrix} 30-24 \\ -10+8 \end{bmatrix} = \begin{bmatrix} 6 \\ -2 \end{bmatrix} \neq 0$

Therefore, given equations are inconsistent, i.e., have no common solution.

Examine the consistency of the system of equations in Exercises 4 to 6.

4. $x + y + z = 1; \quad 2x + 3y + 2z = 2; \quad ax + ay + 2az = 4$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 2 \\ a & a & 2a \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 4 \end{bmatrix}$$

Here A = $\begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 2 \\ a & a & 2a \end{bmatrix}$

$$\therefore\ |A| = \begin{vmatrix} 1 & 1 & 1 \\ 2 & 3 & 2 \\ a & a & 2a \end{vmatrix}$$

$$\Rightarrow |A| = 1(6a-2a) - 1(4a-2a) + 1(2a-3a) = 4a - 2a - a = a \neq 0$$

Therefore, Unique solution and hence equations are consistent.

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5. $3x - y - 2z = 2;\quad 2y - z = -1;\quad 3x - 5y = 3$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 3 & -1 & -2 \\ 0 & 2 & -1 \\ 3 & -5 & 0 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}$$

Here A = $\begin{bmatrix} 3 & -1 & -2 \\ 0 & 2 & -1 \\ 3 & -5 & 0 \end{bmatrix}$

$$\therefore\ |A| = \begin{vmatrix} 3 & -1 & -2 \\ 0 & 2 & -1 \\ 3 & -5 & 0 \end{vmatrix}$$

$$\Rightarrow |A| = 3(0-5) - (-1)(0+3) + (-2)(0-6) = 3(-5) + 3 + 12 = -15 + 15 = 0$$

Now (adj. A) = $\begin{bmatrix} -5 & 10 & 5 \\ -3 & 6 & 3 \\ -6 & 12 & 6 \end{bmatrix}$

And (adj. A) B = $\begin{bmatrix} -5 & 10 & 5 \\ -3 & 6 & 3 \\ -6 & 12 & 6 \end{bmatrix}\begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix} = \begin{bmatrix} -10-10+15 \\ -6-6+9 \\ -12-12+18 \end{bmatrix} = \begin{bmatrix} -5 \\ -3 \\ -6 \end{bmatrix} \neq 0$

Therefore, given equations are inconsistent.

6. $5x - y + 4z = 5;\quad 2x + 3y + 5z = 2;\quad 5x - 2y + 6z = -1$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 5 & -1 & 4 \\ 2 & 3 & 5 \\ 5 & -2 & 6 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 2 \\ -1 \end{bmatrix}$$

Here A = $\begin{bmatrix} 5 & -1 & 4 \\ 2 & 3 & 5 \\ 5 & -2 & 6 \end{bmatrix}$

$$\therefore |A| = \begin{vmatrix} 5 & -1 & 4 \\ 2 & 3 & 5 \\ 5 & -2 & 6 \end{vmatrix}$$

$$\Rightarrow |A| = 5(18+10) - (-1)(12-25) + 4(-4-15) = 140 - 13 - 76 = 140 - 89 = 51 \neq 0$$

Therefore, Unique solution and hence equations are consistent.

Solve the system of linear equations, using matrix method, in Exercise 7 to 10.

7. $5x + 2y = 4;\quad 7x + 3y = 5$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 5 & 2 \\ 7 & 3 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$$

Here A = $\begin{bmatrix} 5 & 2 \\ 7 & 3 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \end{bmatrix}$ and B = $\begin{bmatrix} 4 \\ 5 \end{bmatrix}$

$|A| = \begin{vmatrix} 5 & 2 \\ 7 & 3 \end{vmatrix} = 15 - 14 = 1 \neq 0$

Therefore, solution is unique and $X = A^{-1}B = \frac{1}{|A|}(\text{adj. } A)B$

$\Rightarrow \begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{1}\begin{bmatrix} 3 & -2 \\ -7 & 5 \end{bmatrix}\begin{bmatrix} 4 \\ 5 \end{bmatrix}$

$= \begin{bmatrix} 12-10 \\ -28+25 \end{bmatrix} = \begin{bmatrix} 2 \\ -3 \end{bmatrix}$

Therefore, $x = 2$ and $y = -3$

8. $2x - y = -2; \quad 3x + 4y = 3$

Ans. Matrix form of given equations is AX = B

$\Rightarrow \begin{bmatrix} 2 & -1 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -2 \\ 3 \end{bmatrix}$

Here A = $\begin{bmatrix} 2 & -1 \\ 3 & 4 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \end{bmatrix}$ and B = $\begin{bmatrix} -2 \\ 3 \end{bmatrix}$

$\therefore |A| = \begin{vmatrix} 2 & -1 \\ 3 & 4 \end{vmatrix} = 8 - (-3) = 8 + 3 = 11 \neq 0$

Therefore, solution is unique and $X = A^{-1}B = \frac{1}{|A|}(\text{adj. } A)B$

$\Rightarrow \begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{11}\begin{bmatrix} 4 & 1 \\ -3 & 2 \end{bmatrix}\begin{bmatrix} -2 \\ 3 \end{bmatrix}$

$= \frac{1}{11}\begin{bmatrix} -8+3 \\ 6+6 \end{bmatrix} = \frac{1}{11}\begin{bmatrix} -5 \\ 12 \end{bmatrix}$

= $\begin{bmatrix} -5/11 \\ 12/11 \end{bmatrix}$

Therefore, $x = \frac{-5}{11}$ and $y = \frac{12}{11}$

9. $4x - 3y = 3; \quad 3x - 5y = 7$

Ans. Matrix form of given equations is AX = B

$\Rightarrow \begin{bmatrix} 4 & -3 \\ 3 & -5 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 \\ 7 \end{bmatrix}$

Here A = $\begin{bmatrix} 4 & -3 \\ 3 & -5 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \end{bmatrix}$ and B = $\begin{bmatrix} 3 \\ 7 \end{bmatrix}$

$\therefore |A| = \begin{vmatrix} 4 & -3 \\ 3 & -5 \end{vmatrix}$ = $-20 - (-9) = -20 + 9 = -11 \neq 0$

Therefore, solution is unique and $X = A^{-1}B$ = $\frac{1}{|A|}(\text{adj. } A)B$

$\Rightarrow \begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{-11}\begin{bmatrix} -5 & 3 \\ -3 & 4 \end{bmatrix}\begin{bmatrix} 3 \\ 7 \end{bmatrix}$

= $\frac{1}{-11}\begin{bmatrix} -15+21 \\ -9+28 \end{bmatrix} = \frac{1}{-11}\begin{bmatrix} 6 \\ 19 \end{bmatrix}$

= $\begin{bmatrix} -6/11 \\ -19/11 \end{bmatrix}$

Therefore, $x = \frac{-6}{11}$ and $y = \frac{-19}{11}$

10. $5x+2y=3;\quad 3x+2y=5$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix}5 & 2\\3 & 2\end{bmatrix}\begin{bmatrix}x\\y\end{bmatrix}=\begin{bmatrix}3\\5\end{bmatrix}$$

Here A = $\begin{bmatrix}5 & 2\\3 & 2\end{bmatrix}$, X = $\begin{bmatrix}x\\y\end{bmatrix}$ and B = $\begin{bmatrix}3\\5\end{bmatrix}$

$$\therefore\ |A|=\begin{vmatrix}5 & 2\\3 & 2\end{vmatrix} = 10-6=4\neq 0$$

Therefore, solution is unique and $X=A^{-1}B = \frac{1}{|A|}(\text{adj. }A)B$

$$\Rightarrow \begin{bmatrix}x\\y\end{bmatrix}=\frac{1}{4}\begin{bmatrix}2 & -2\\-3 & 5\end{bmatrix}\begin{bmatrix}3\\5\end{bmatrix}$$

$$= \frac{1}{4}\begin{bmatrix}6-10\\-9+25\end{bmatrix}=\frac{1}{4}\begin{bmatrix}-4\\16\end{bmatrix}=\begin{bmatrix}-1\\4\end{bmatrix}$$

Therefore, $x=-1$ and $y=4$

Solve the system of linear equations, using matrix method, in Exercise 11 to 14.

11. $2x+y+z=1;\quad x-2y-z=\frac{3}{2};\quad 3y-5z=9$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix}2 & 1 & 1\\1 & -2 & -1\\0 & 3 & -5\end{bmatrix}\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}1\\3/2\\9\end{bmatrix}$$

Here A = $\begin{bmatrix} 2 & 1 & 1 \\ 1 & -2 & -1 \\ 0 & 3 & -5 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and B = $\begin{bmatrix} 1 \\ 3/2 \\ 9 \end{bmatrix}$

$\therefore\ |A| = \begin{vmatrix} 2 & 1 & 1 \\ 1 & -2 & -1 \\ 0 & 3 & -5 \end{vmatrix}$ = $2(10+3)-1(-5-0)+1(3-0)$ = $26+5+3=34\neq 0$

Therefore, solution is unique and $X = A^{-1}B$ = $\frac{1}{|A|}(\text{adj. } A)B$

$$\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{34}\begin{bmatrix} 13 & 8 & 1 \\ 5 & -10 & 3 \\ 3 & -6 & -5 \end{bmatrix}\begin{bmatrix} 1 \\ 3/2 \\ 9 \end{bmatrix}$$

$$= \frac{1}{34}\begin{bmatrix} 13+12+9 \\ 5-15+27 \\ 3-9-45 \end{bmatrix}$$

$$= \frac{1}{34}\begin{bmatrix} 34 \\ 17 \\ -51 \end{bmatrix} = \begin{bmatrix} 1 \\ 1/2 \\ -3/2 \end{bmatrix}$$

Therefore, $x=1, y=\frac{1}{2}$ and $z=\frac{3}{2}$

12. $x-y+z=4;\quad 2x+y-3z=0;\quad x+y+z=2$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$$

Here A = $\begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and B = $\begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$

$$\therefore |A| = \begin{vmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{vmatrix}$$

= $1(1+3)-(-1)(2+3)+1(2-1)$

= $4+5+1=10 \neq 0$

Therefore, solution is unique and $X = A^{-1}B$ = $\frac{1}{|A|}(\text{adj. } A)B$

$$\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{10}\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}\begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$$

= $\frac{1}{10}\begin{bmatrix} 16+0+4 \\ -20+0+10 \\ 4-0+6 \end{bmatrix}$

= $\frac{1}{10}\begin{bmatrix} 20 \\ -10 \\ 10 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$

Therefore, $x = 2$, $y = -1$ and $z = 1$

13. $2x+3y+3z=5; \quad x-2y+z=-4; \quad 3x-y-2z=3$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 2 & 3 & 3 \\ 1 & -2 & 1 \\ 3 & -1 & -2 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ -4 \\ 3 \end{bmatrix}$$

Here A = $\begin{bmatrix} 2 & 3 & 3 \\ 1 & -2 & 1 \\ 3 & -1 & -2 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and B = $\begin{bmatrix} 5 \\ -4 \\ 3 \end{bmatrix}$

$$\therefore |A| = \begin{vmatrix} 2 & 3 & 3 \\ 1 & -2 & 1 \\ 3 & -1 & -2 \end{vmatrix}$$

= $2(4+1)-3(-2-3)+3(-1+6)$

= $10+15+15=40 \neq 0$

Therefore, solution is unique and $X = A^{-1}B$ = $\frac{1}{|A|}(\text{adj. } A)B$

$$\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{40}\begin{bmatrix} 5 & 3 & 9 \\ 5 & -13 & 1 \\ 5 & 11 & -7 \end{bmatrix}\begin{bmatrix} 5 \\ -4 \\ 3 \end{bmatrix}$$

= $\frac{1}{40}\begin{bmatrix} 25-12+27 \\ 25+52+3 \\ 25-44-21 \end{bmatrix}$

= $\frac{1}{40}\begin{bmatrix} 40 \\ 80 \\ -40 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$

Therefore, $x=1, y=2$ and $z=-1$

14. $x-y+2z=7;\quad 3x+4y-5z=-5;\quad 2x-y+3z=12$

Ans. Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 1 & -1 & 2 \\ 3 & 4 & -5 \\ 2 & -1 & 3 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 \\ -5 \\ 12 \end{bmatrix}$$

Here A = $\begin{bmatrix} 1 & -1 & 2 \\ 3 & 4 & -5 \\ 2 & -1 & 3 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and B = $\begin{bmatrix} 7 \\ -5 \\ 12 \end{bmatrix}$

$$\therefore |A| = \begin{vmatrix} 1 & -1 & 2 \\ 3 & 4 & -5 \\ 2 & -1 & 3 \end{vmatrix}$$

= $1(12-5)-(-1)(9+10)+2(-3-8)$

= $7+9-22=4\neq 0$

Therefore, solution is unique and $X = A^{-1}B$ = $\frac{1}{|A|}(\text{adj. }A)B$

$$\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{4}\begin{bmatrix} 7 & 1 & -3 \\ -19 & -1 & 11 \\ -11 & -1 & 7 \end{bmatrix}\begin{bmatrix} 7 \\ -5 \\ 12 \end{bmatrix}$$

= $\frac{1}{4}\begin{bmatrix} 49-5-36 \\ -133+5+132 \\ -77+5+84 \end{bmatrix}$

$= \frac{1}{4}\begin{bmatrix} 8 \\ 4 \\ 12 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}$

Therefore, $x = 2$, $y = 1$ and $z = 3$

15. If A = $\begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$, find A^{-1}. Using A^{-1} solve the system of equations $2x-3y+5z=11$; $3x+2y-4z=-5$; $x+y-2z=-3$.

Ans. Given: Matrix A = $\begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$

$\therefore\ |A| = \begin{vmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{vmatrix}$

$\Rightarrow |A| = 2(-4+4)-(-3)(-6+4)+5(3-2) = 0-6+5=-1 \neq 0$

$\therefore\ A^{-1}$ exists and $A^{-1} = \frac{1}{|A|}(\text{adj. } A)$ ....(i)

Now, $A_{11}=0, A_{12}=2, A_{13}=1$ and $A_{21}=-1, A_{22}=-9, A_{23}=-5$ and $A_{31}=2, A_{32}=23, A_{33}=13$

$\therefore$ adj. A = $\begin{bmatrix} 0 & 2 & 1 \\ -1 & -9 & -5 \\ 2 & 23 & 13 \end{bmatrix}' = \begin{bmatrix} 0 & -1 & 2 \\ 2 & -9 & 23 \\ 1 & -5 & 13 \end{bmatrix}$

From eq. (i),

$$A^{-1} = \frac{1}{-1}\begin{bmatrix} 0 & -1 & 2 \\ 2 & -9 & 23 \\ 1 & -5 & 13 \end{bmatrix} = \begin{bmatrix} 0 & 1 & -2 \\ -2 & 9 & -23 \\ -1 & 5 & -13 \end{bmatrix}$$

Now, Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix}$$

Here A = $\begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and B = $\begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix}$

Therefore, solution is unique and $X = A^{-1}B$

$$\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 & 1 & -2 \\ -2 & 9 & -23 \\ -1 & 5 & -13 \end{bmatrix}\begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix}$$

$$= \begin{bmatrix} 0-5+6 \\ -22-45+69 \\ -11-25+39 \end{bmatrix}$$

$$= \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

Therefore, $x = 1$, $y = 2$ and $z = 3$

16. The cost of 4 kg onion, 3 kg wheat and 2 kg rice is Rs 60. The cost of 2 kg onion, 4 kg wheat and 2 kg rice is Rs 90. The cost of 6 kg onion, 2 k wheat and 3 kg rice is Rs 70. Find cost of each item per kg by matrix method.

Ans. Let Rs x, Rs y, Rs z per kg be the prices of onion, wheat and rice respectively.

$\therefore$ According to given data, we have three equations,

$4x+3y+2z=60$

$2x+4y+6z=90$

$6x+2y+3z=70$

Matrix form of given equations is AX = B

$$\Rightarrow \begin{bmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 60 \\ 90 \\ 70 \end{bmatrix}$$

Here A = $\begin{bmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{bmatrix}$, X = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and B = $\begin{bmatrix} 60 \\ 90 \\ 70 \end{bmatrix}$

$$\therefore |A| = \begin{vmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{vmatrix} = 4(12-12)-3(6-36)+2(4-24) = 0+90-40=50 \neq 0$$

Therefore, solution is unique and $X = A^{-1}B = \frac{1}{|A|}(\text{adj. } A)B$ ....(i)

Now, $A_{11}=0, A_{12}=30, A_{13}=-20$

$A_{21}=-5, A_{22}=0, A_{23}=10$

$A_{31}=10, A_{32}=-20, A_{33}=10$

$$\therefore \text{adj. } A = \begin{bmatrix} 0 & 30 & -20 \\ -5 & 0 & 10 \\ 10 & -20 & 10 \end{bmatrix}' = \begin{bmatrix} 0 & -5 & 10 \\ 30 & 0 & -20 \\ -20 & 10 & 10 \end{bmatrix}$$

$\Rightarrow$ From eq. (i),

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{50}\begin{bmatrix} 0 & -5 & 10 \\ 30 & 0 & -20 \\ -20 & 10 & 10 \end{bmatrix}\begin{bmatrix} 60 \\ 90 \\ 70 \end{bmatrix}$$

$$= \frac{1}{50}\begin{bmatrix} -450+700 \\ 1800-1400 \\ -1200+900+700 \end{bmatrix}$$

$$= \frac{1}{50}\begin{bmatrix} 250 \\ 400 \\ 400 \end{bmatrix} = \begin{bmatrix} 5 \\ 8 \\ 8 \end{bmatrix}$$

Therefore, $x = 5, y = 8$ and $z = 8$

Hence, the cost of onion, wheat and rice are Rs. 5, Rs 8 and Rs 8 per kg.