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Exercise 1.2

i) $2x+3y=7,\ 3x+5y=9$

$$\Delta = \begin{vmatrix} 2 & 3 \\ 3 & 5 \end{vmatrix}$$

$\Delta = 10-9$

$\boxed{\Delta = 1} \neq 0$

(Cramer's rule is applicable)

$$\Delta_x = \begin{vmatrix} 7 & 3 \\ 9 & 5 \end{vmatrix}$$

$= 35-27$

$\boxed{\Delta_x = 8}$

$$\Delta_y = \begin{vmatrix} 2 & 7 \\ 3 & 9 \end{vmatrix}$$

$= 18-21$

$\boxed{\Delta_y = -3}$

$x = \frac{\Delta_x}{\Delta} = \frac{8}{1} = 8$

$y = \frac{\Delta_y}{\Delta} = \frac{-3}{1} = -3$

$x=8 \quad y=-3$

ii) $5x+3y=17,\ 3x+7y=31$

$$\Delta = \begin{vmatrix} 5 & 3 \\ 3 & 7 \end{vmatrix}$$

$\Delta = 35-9$

$\Delta = 26 \neq 0$

$$\Delta_x = \begin{vmatrix} 17 & 3 \\ 31 & 7 \end{vmatrix}$$

$= 119-93$

$= 26$

$$\Delta_y = \begin{vmatrix} 5 & 17 \\ 3 & 31 \end{vmatrix}$$

$= 155-51$

$\Delta_y = 104$

$x = \frac{\Delta_x}{\Delta} = \frac{26}{26} = 1$

$y = \frac{\Delta_y}{\Delta} = \frac{104}{26} = 4$

$\boxed{x=1} \quad \boxed{y=4}$

ii) $2x+y-z=3$

$x+y+z=1$

$x-2y-3z=4$

$$\Delta = \begin{vmatrix} 2 & 1 & -1 \\ 1 & 1 & 1 \\ 1 & -2 & -3 \end{vmatrix}$$

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

$= 2|-3+2| - 1|-3-1| - 1|-2-1|$

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

$= -2+4+3$

$= -2+7$

$= 5 \neq 0$ (∵ Cramer's rule is applicable)

$$\Delta_x = \begin{vmatrix} 3 & 1 & -1 \\ 1 & 1 & 1 \\ 4 & -2 & -3 \end{vmatrix}$$

$= 3\begin{vmatrix} 1 & 1 \\ -2 & -3 \end{vmatrix} - 1\begin{vmatrix} 1 & 1 \\ 4 & -3 \end{vmatrix} - 1\begin{vmatrix} 1 & 1 \\ 4 & -2 \end{vmatrix}$

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

$= 3(-1) - 1(-7) - 1(-6)$

$= -3+7+6$

$= -3+13$

$\Delta_x = 10$

$$\Delta_y = \begin{vmatrix} 2 & 3 & -1 \\ 1 & 1 & 1 \\ 1 & 4 & -3 \end{vmatrix}$$

$= 2\begin{vmatrix} 1 & 1 \\ 4 & -3 \end{vmatrix} - 3\begin{vmatrix} 1 & 1 \\ 1 & -3 \end{vmatrix} - 1\begin{vmatrix} 1 & 1 \\ 1 & 4 \end{vmatrix}$

$= 2|-3-4| - 3|-3-1| - 1|4-1|$

$= 2|-7| - 3|-4| - 1(3)$

$= -14+12-3$

$= -14+9$

$\Delta_y = -5$

$$\Delta_z = \begin{vmatrix} 2 & 1 & 3 \\ 1 & 1 & 1 \\ 1 & -2 & 4 \end{vmatrix}$$

$= 2\begin{vmatrix} 1 & 1 \\ -2 & 4 \end{vmatrix} - 1\begin{vmatrix} 1 & 1 \\ 1 & 4 \end{vmatrix} + 3\begin{vmatrix} 1 & 1 \\ 1 & -2 \end{vmatrix}$

$= 2|4+2| - 1|4-1| + 3|-2-1|$

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

$= 12-3-9$

$= 12-12$

$\Delta_z = 0$

$x = \frac{\Delta_x}{\Delta} = \frac{10}{5} = 2$

$y = \frac{\Delta_y}{\Delta} = \frac{-5}{5} = -1$

$z = \frac{\Delta_z}{\Delta} = \frac{0}{5} = 0$

$x=2 \quad y=-1 \quad z=0$

14) $x+y+z=6$

$2x+3y-z=5$

$6x-2y-3z=-7$

$$\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 2 & 3 & -1 \\ 6 & -2 & -3 \end{vmatrix}$$

$\Delta = 1\begin{pmatrix} 3 & -1 \\ -2 & -3 \end{pmatrix} - 1\begin{pmatrix} 2 & -1 \\ 6 & -3 \end{pmatrix} + 1\begin{pmatrix} 2 & 3 \\ 6 & -2 \end{pmatrix}$

$= 1(-9-2) - 1(-6+6) + 1(-4-18)$

$= 1(-11) - 1(0) + 1(-22)$

$= -11 - 22$

$= -33 \neq 0$

$$\Delta x = \begin{vmatrix} 6 & 1 & 1 \\ 5 & 3 & -1 \\ -7 & -2 & -3 \end{vmatrix}$$

$\Delta x = 6\begin{pmatrix} 3 & -1 \\ -2 & -3 \end{pmatrix} - 1\begin{pmatrix} 5 & -1 \\ -7 & -3 \end{pmatrix} + 1\begin{pmatrix} 5 & 3 \\ -7 & -2 \end{pmatrix}$

$= 6(-9-2) - 1(-15-7) + 1(-10+21)$

$= 6(-11) - 1(-22) + 1(11)$

$= -66+22+11$

$\boxed{\Delta x = -33}$

$$\Delta y = \begin{vmatrix} 1 & 6 & 1 \\ 2 & 5 & -1 \\ 6 & -7 & -3 \end{vmatrix}$$

$= 1\begin{pmatrix} 5 & -1 \\ -7 & -3 \end{pmatrix} - 6\begin{pmatrix} 2 & -1 \\ 6 & -3 \end{pmatrix} + 1\begin{pmatrix} 2 & 5 \\ 6 & -7 \end{pmatrix}$

$= 1(-15-7) - 6(-6+6) + 1(-14-30)$

$= -22 - 0 - 44$

$\Delta y = -66$

$$\Delta z = \begin{vmatrix} 1 & 1 & 6 \\ 2 & 3 & 5 \\ 6 & -2 & -7 \end{vmatrix}$$

$\Delta z = 1\begin{pmatrix} 3 & 5 \\ -2 & -7 \end{pmatrix} - 1\begin{pmatrix} 2 & 5 \\ 6 & -7 \end{pmatrix} + 6\begin{pmatrix} 2 & 3 \\ 6 & -2 \end{pmatrix}$

$= 1(-21+10) - 1(-14-30) + 6(-4-18)$

$= 1(-11) - 1(-44) + 6(-22)$

$= -11+44-132$

$\Delta z = -99$

$x = \frac{\Delta x}{\Delta} = \frac{-33}{-33} = 1$

$y = \frac{\Delta y}{\Delta} = \frac{-66}{-33} = 2$

$z = \frac{\Delta z}{\Delta} = \frac{-99}{-33} = 3$

V) $x+4y+3z=2$

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

$5x-2y+3z=-5$

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

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

$= 1(-18+12) - 4(6-30) + 3(-4+30)$

$= 1(-6) - 4(-24) + 3(26)$

$= -6 + 96 + 78$

$\Delta = 168 \neq 0$

$$\Delta_x = \begin{vmatrix} 2 & 4 & 3 \\ -3 & -6 & 6 \\ -5 & -2 & 3 \end{vmatrix}$$

$= 2\begin{pmatrix} -6 & 6 \\ -2 & 3 \end{pmatrix} - 4\begin{pmatrix} -3 & 6 \\ -5 & 3 \end{pmatrix} + 3\begin{pmatrix} -3 & -6 \\ -5 & -2 \end{pmatrix}$

$= 2(-18+12) - 4(-9+30) + 3(6-30)$

$= 2(-6) - 4(21) + 3(-24)$

$= -12 - 84 - 72$

$\Delta_x = -168$

$$\Delta_y = \begin{vmatrix} 1 & 2 & 3 \\ 2 & -3 & 6 \\ 5 & -5 & 3 \end{vmatrix}$$

$\Delta_y = 1\begin{pmatrix} -3 & 6 \\ -5 & 3 \end{pmatrix} - 2\begin{pmatrix} 2 & 6 \\ 5 & 3 \end{pmatrix} + 3\begin{pmatrix} 2 & -3 \\ 5 & -5 \end{pmatrix}$

$= 1(-9+30) - 2(6-30) + 3(-10+15)$

$= 1(21) - 2(-24) + 3(5)$

$= 21 + 48 + 15$

$\Delta_y = 84$

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

$= 1\begin{pmatrix} -6 & -3 \\ -2 & -5 \end{pmatrix} - 4\begin{pmatrix} 2 & -3 \\ 5 & -5 \end{pmatrix} + 2\begin{pmatrix} 2 & -6 \\ 5 & -2 \end{pmatrix}$

$= 1(30-6) - 4(-10+15) + 2(-4+30)$

$= 1(24) - 4(5) + 2(26)$

$= 24 - 20 + 52$

$\Delta_z = 56$

$x = \frac{\Delta_x}{\Delta} = \frac{-168}{168} = -1$

$y = \frac{\Delta_y}{\Delta} = \frac{84^{1}}{168_{2}} = \frac{1}{2}$

$z = \frac{\Delta_z}{\Delta} = \frac{56^{1}}{168_{3}} = \frac{1}{3}$

2) $3x+2y=62$

$4x+y=56$

$$\Delta = \begin{vmatrix} 3 & 2 \\ 4 & 1 \end{vmatrix}$$

$= 3-8$

$\Delta = -5$

$$\Delta_x = \begin{vmatrix} 62 & 2 \\ 56 & 1 \end{vmatrix}$$

$= 62-112$

$\Delta_x = -50$

$$\Delta_y = \begin{vmatrix} 3 & 62 \\ 4 & 56 \end{vmatrix}$$

$= 168-248$

$\Delta_y = -80$

$$x = \frac{\Delta_x}{\Delta} = \frac{-50}{-5} = 10$$

$$y = \frac{\Delta_y}{\Delta} = \frac{-80}{-5} = 16$$

$x=10 \quad y=16$

3) $x+y = 8600$

$4\frac{3}{4}\%x + 6\frac{1}{2}\%y = 431.25$

$$\frac{19x}{400} + \frac{13y}{200} = 431.25$$

$$\frac{19x+26y}{400} = 431.25$$

$19x+26y = 431.25 \times 400$

$19x+26y = 172500$

$$\Delta = \begin{vmatrix} 1 & 1 \\ 19 & 26 \end{vmatrix}$$

$= 26-19$

$= 7 \neq 0$

$$\Delta_x = \begin{vmatrix} 8600 & 1 \\ 172500 & 26 \end{vmatrix}$$

$\Delta_x = 223600 - 172500$

$\boxed{\Delta_x = 51100}$

$$\Delta_y = \begin{vmatrix} 1 & 8600 \\ 19 & 172500 \end{vmatrix}$$

$= 172500 - 163400$

$\boxed{\Delta_y = 9100}$

$$x = \frac{\Delta_x}{\Delta} = \frac{51100}{7} = 7300$$

$$y = \frac{\Delta_y}{\Delta} = \frac{9100}{7} = 1300$$

The investment in each account is ₹ 7300 ₹ 1300

4) $3x+4y=780$

$2x+3y=560$

$$\Delta = \begin{vmatrix} 3 & 4 \\ 2 & 3 \end{vmatrix}$$

$= 9-8$

$\Delta = 1 \neq 0$

$$\Delta_x = \begin{vmatrix} 780 & 4 \\ 560 & 3 \end{vmatrix}$$

$= 2340 - 2240$

$\Delta_x = 100$

$$\Delta_y = \begin{vmatrix} 3 & 780 \\ 2 & 560 \end{vmatrix}$$

$= 1680 - 1560$

$\Delta_y = 120$

$$x = \frac{\Delta_x}{\Delta} = \frac{100}{1} = 100$$

$$y = \frac{\Delta_y}{\Delta} = \frac{120}{1} = 120$$

$= -9 + 33 - 27$

$\Delta_y = -3$

$\Delta_z = \begin{vmatrix} 1 & 2 & 11 \\ 2 & 4 & 21 \\ 3 & 5 & 27 \end{vmatrix}$

$= 1\begin{vmatrix} 4 & 21 \\ 5 & 27 \end{vmatrix} - 2\begin{vmatrix} 2 & 21 \\ 3 & 27 \end{vmatrix} + 11\begin{vmatrix} 2 & 4 \\ 3 & 5 \end{vmatrix}$

$= 1(108-105) - 2(54-63) + 11(10-12)$

$= 1(3) - 2(-9) + 11(-2)$

$= 3 + 18 - 22$

$= -1$

$x = \frac{\Delta x}{\Delta} = \frac{-2}{-1} = 2$

$y = \frac{\Delta y}{\Delta} = \frac{-3}{-1} = 3$

$z = \frac{\Delta z}{\Delta} = \frac{-1}{-1} = 1$

The weights assigned to the three Varieties are 2, 3, 1

5) $x + 2y + 3z = 11$

$2x + 4y + 5z = 21$

$3x + 5y + 6z = 27$

$\Delta = \begin{vmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{vmatrix}$

$\Delta = 1\begin{pmatrix} 4 & 5 \\ 5 & 6 \end{pmatrix} - 2\begin{pmatrix} 2 & 5 \\ 3 & 6 \end{pmatrix} + 3\begin{pmatrix} 2 & 4 \\ 3 & 5 \end{pmatrix}$

$= 1(24-25) - 2(12-15) + 3(10-12)$

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

$= -1 + 6 - 6$

$\Delta = -1 \neq 0$ (∵ Cramer's rule is applicable)

$\Delta_x = \begin{vmatrix} 11 & 2 & 3 \\ 21 & 4 & 5 \\ 27 & 5 & 6 \end{vmatrix}$

$\Delta_x = 11\begin{pmatrix} 4 & 5 \\ 5 & 6 \end{pmatrix} - 2\begin{pmatrix} 21 & 5 \\ 27 & 6 \end{pmatrix} + 3\begin{pmatrix} 21 & 4 \\ 27 & 5 \end{pmatrix}$

$= 11(24-25) - 2(126-135) + 3(105 - 108)$

$= 11(-1) - 2(-9) + 3(-3)$

$= -11 + 18 - 9$

$\Delta_x = -2$

$\Delta_y = \begin{vmatrix} 1 & 11 & 3 \\ 2 & 21 & 5 \\ 3 & 27 & 6 \end{vmatrix}$

$= 1\begin{vmatrix} 21 & 5 \\ 27 & 6 \end{vmatrix} - 11\begin{vmatrix} 2 & 5 \\ 3 & 6 \end{vmatrix} + 3\begin{vmatrix} 2 & 21 \\ 3 & 27 \end{vmatrix}$

$= 1(126-135) - 11(12-15) + 3(54-63$

$= 1(-9) - 11(-3) + 3(-9)$

6) $x+y+z=8500 \rightarrow (1)$

$2\%x+3\%y+6\%z=380$

$2x+3y+6z=38000 \rightarrow (2)$

$z=x+y$

$x+y-z=0 \rightarrow (3)$

$$\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 2 & 3 & 6 \\ 1 & 1 & -1 \end{vmatrix}$$

$= 1\begin{pmatrix} 3 & 6 \\ 1 & -1 \end{pmatrix} - 1\begin{pmatrix} 2 & 6 \\ 1 & -1 \end{pmatrix} + 1\begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$

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

$= 1(-9) - 1(-8) + 1(-1)$

$= -9+8-1$

$= -10+8$

$\Delta = -2 \neq 0$

$$\Delta_x = \begin{vmatrix} 8500 & 1 & 1 \\ 38000 & 3 & 6 \\ 0 & 1 & -1 \end{vmatrix}$$

$= 8500\begin{pmatrix} 3 & 6 \\ 1 & -1 \end{pmatrix} - 1\begin{pmatrix} 38000 & 6 \\ 0 & -1 \end{pmatrix} + 1\begin{pmatrix} 38000 & 3 \\ 0 & 1 \end{pmatrix}$

$= 8500(-3-6) - 1(-38000-0) + 1(38000-0)$

$= 8500(-9) + 38000 + 38000$

$= -76500 + 76000$

$\Delta_x = -500$

$$\Delta_y = \begin{pmatrix} 1 & 8500 & 1 \\ 2 & 38000 & 6 \\ 1 & 0 & -1 \end{pmatrix}$$

$= 1\begin{pmatrix} 38000 & 6 \\ 0 & -1 \end{pmatrix} - 8500\begin{pmatrix} 2 & 6 \\ 1 & -1 \end{pmatrix} + 1\begin{pmatrix} 2 & 38000 \\ 1 & 0 \end{pmatrix}$

$= 1(-38000-0) - 8500(-2-6) + (38000-0)$

$= -38000 - 8500(-8) + 38000$

$= -38000 + 68000 - 38000$

$\Delta_y = -8000$

$$\Delta_z = \begin{bmatrix} 1 & 1 & 8500 \\ 2 & 3 & 38000 \\ 1 & 1 & 0 \end{bmatrix}$$

$= 1\begin{pmatrix} 3 & 38000 \\ 1 & 0 \end{pmatrix} - 1\begin{pmatrix} 2 & 38000 \\ 1 & 0 \end{pmatrix} + 8500\begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$

$= 1(0-38000) - 1(0-38000) + 8500(2-3)$

$= -38000 + 38000 - 8500$

$\Delta_z = -8500$

$$x = \frac{\Delta_x}{\Delta} = \frac{-500}{-2} = 250$$

$$y = \frac{\Delta_y}{\Delta} = \frac{-8000}{-2} = 4000$$

$$z = \frac{\Delta_z}{\Delta} = \frac{-8500}{-2} = 4250$$

The amount invested in each account is ₹ 250 ₹ 4000 ₹ 4250 .

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