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Matrices

$x = A$, $y = B$, $z x$

let x, y and z be the cost/kg of Pakistani, Egyptian and American cotton respectively

According to the condition

$\frac{1}{4}x + \frac{2}{4}y + \frac{1}{4}z = 40 \longrightarrow ①$ sum of ratio = 4

$\frac{2}{4}x + \frac{1}{4}y + \frac{1}{4}z = 50 \longrightarrow ②$

$\frac{2}{4}x + \frac{2}{4}z = 60 \longrightarrow ③$

multiplying '4' on b.s of equations ①, ② & ③ : we get

① $\Rightarrow x + 2y + z = 160$

② $\Rightarrow 2x + y + z = 200$

③ $\Rightarrow 2x + 0y + z = 120$

Now, we arrange the eq in matrix form

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 2 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 160 \\ 200 \\ 120 \end{bmatrix}$$

$\therefore$

$$A_1 = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 2 & 0 & 1 \end{bmatrix}, \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, \quad B_1 = \begin{bmatrix} 160 \\ 200 \\ 120 \end{bmatrix}$$

$\Rightarrow A_1 \times B_1$

Now,

Using Cramer's Rule

$$A_1x = \begin{bmatrix} 160 & 2 & 1 \\ 200 & 1 & 1 \\ 120 & 0 & 1 \end{bmatrix}$$ We replace B_1 in 1st colume of A_1

$$|A_1x| = 160\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} - 2\begin{bmatrix} 200 & 1 \\ 120 & 1 \end{bmatrix} + \begin{bmatrix} 200 & 1 \\ 120 & 0 \end{bmatrix}$$

$$= 160(1-0) - 2(200-120) + 1(0-120)$$

$$= 160 - 2(80) - 120 = 160 - 160 - 120$$

$$|A_1x| = -120$$

Now,

$$x \frac{|A_1x|}{|A_1|} \longrightarrow (4)$$

Now finding $|A_1|$

$$|A_1| = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix} = 1(1-0) - 2(2-1) + 1(0-1)$$

$$= 1 - 2 - 1 = -2$$

Now

$$(4) \Rightarrow x \frac{|A_1x|}{|A_1|} = \frac{-120}{-2} = 60$$

$$x = A = 60$$

also,

$$y = \frac{|A_1y|}{|A_1|} \longrightarrow (5)$$

A_1y $\begin{bmatrix} 1 & 160 & 1 \\ 2 & 200 & 1 \\ 1 & 120 & 1 \end{bmatrix}$ replace B_1 in 2nd col. of A_1

$$|A_1y| = 1(200-120) - 160(2-1) + 1(240-200)$$

$$= 80 - 160 + 40$$

$$|A_1y| = -40$$

⑤ $\Rightarrow y = \frac{|A_{1y}|}{|A_1|} = \frac{-40}{-2} = 20$

$y = B = 20$

again $z = \frac{|A_{1z}|}{|A_1|} \longrightarrow ⑥$

$$A_{1z} = \begin{bmatrix} 1 & 2 & 160 \\ 2 & 1 & 200 \\ 1 & 0 & 120 \end{bmatrix}$$

$|A_{1z}| = 1(120-0) - 2(240-200) + 160(0-1)$

$= 120 - 80 - 160$

$= 120$

⑥ $\Rightarrow z = \frac{|A_{1z}|}{|A_1|} = \frac{-120}{-2} = 60$

$z = C = 60$

Hence

$(x, y, z) = (60, 20, 60)$

or

$(A, B, C) = (60, 20, 60)$

which implies that

Pakistani blend cost/kg of cotton = 60

Egyptian " " " " = 20

American " " " " = 60