Step-1

Let us consider the following matrix

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

Now, in a mixed strategy, for columns, use the frequency x_1 and $x_2 = 1 - x_1$

Thus, we have the following expression

$$ax_1 + b(1 - x_1) = cx_1 + d(1 - x_1)$$
$$x_1(a - b - c + d) = d - b$$

$$\boxed{x_1 = \frac{d - b}{a - b - c + d}}$$ â€¦â€¦ (1)

And

$$1 - x_1 = 1 - \frac{d - b}{a - b - c + d}$$
$$= \frac{a - b - c + d - d + b}{a - b - c + d}$$

$$1 - x_1 = \boxed{\frac{a - c}{a - b - c + d}}$$ â€¦â€¦ (2)

Step-2

Similarly, in a mixed strategy, for rows, use the frequency y_1 and $y_2 = 1 - y_1$

Thus, we have the following expression

$$ay_1 + c(1 - y_1) = by_1 + d(1 - y_1)$$
$$y_1(a - c - b + d) = d - c$$

$$\boxed{y_1 = \frac{d - c}{a - c - b + d}}$$ â€¦â€¦ (3)

And

$$1-y_1 = 1-\frac{d-c}{a-c-b+d}$$
$$= \frac{a-c-b+d-d+c}{a-c-b+d}$$

$1-y_1 = \boxed{\frac{a-b}{a-c-b+d}}$ â€¦â€¦ (4)

But, the expression for u is as follows

$$u = ax_1 + b(1-x_1)$$

$u = a\left(\frac{d-b}{a-b-c+d}\right)+b\left(\frac{a-c}{a-b-c+d}\right)$ (From equation (1) and equation (2))

$$u = \frac{ad-ab+ab-bc}{a-b-c+d}$$

$u = \boxed{\frac{ad-bc}{a-b-c+d}}$ â€¦â€¦ (5)

Step-3

Similarly, the expression for v is as follows

$$v = ay_1 + c(1-y_1)$$

$v = a\left(\frac{d-c}{a-c-b+d}\right)+c\left(\frac{a-b}{a-c-b+d}\right)$ (From equation (3) and equation (4))

$$v = \frac{ad-ac+ac-bc}{a-c-b+d}$$

$v = \boxed{\frac{ad-bc}{a-b-c+d}}$ â€¦â€¦ (6)

Thus, from expressions (5), and (6), it is observed that $\boxed{u=v}$