Step-1

We know that Markov matrix has no negative entries, $a_{ij} \geq 0$ and each column of the matrix adding to 1.

Consider A is a Markov matrix and let $y = Ax$, here x is a vector.

We have to show that the sum of the components of y is equal to the sum of the components of vector x.

We know that for a vector x, the sum of the component of x is given by

$$\begin{aligned} x_1 + x_2 + x_3 + \cdots + x_n &= \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix} \\ &= \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} x \end{aligned}$$

We have considered A is Markov matrix, so we have

$$\begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} A = \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix}$$

Step-2

The sum of the components of y is given by

$$\begin{aligned} y_1 + y_2 + y_3 + \cdots + y_n &= \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} \begin{bmatrix} y \\ \vdots \\ y_n \end{bmatrix} \\ &= \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} y \end{aligned}$$

Since $y = Ax$ and $\begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} A = \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix}$, so we have

$$\begin{aligned} y_1 + y_2 + y_3 + \cdots + y_n &= \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} y \\ &= \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} Ax \\ &= \begin{bmatrix} 1 & \cdots & 1 \end{bmatrix} x \\ &= x_1 + x_2 + x_3 + \cdots + x_n \end{aligned}$$

Therefore, the sum of the components of y is $\boxed{\text{equal}}$ to the sum of the components of vector x.

Step-3

We know that each column of the Markov matrix adding to 1, so the component of Ax is given by

$$x_1 + x_2 + x_3 + \cdots + x_n$$

And the component of λx is given by

$$\lambda\left(x_1 + x_2 + x_3 + \cdots + x_n\right)$$

If $Ax = \lambda x$ then we have

$$x_1 + x_2 + x_3 + \cdots + x_n = \lambda\left(x_1 + x_2 + x_3 + \cdots + x_n\right).$$

Since $\lambda \neq 1$ then $x_1 + x_2 + x_3 + \cdots + x_n$ must be $\boxed{\text{zero}}$.