Step-1

When $t=0$, $A(t)=A$ and as $t\to\infty$, $A(t)\to I$. Also, for any *t*, the determinant of $A(t)$ cannot be negative. Thus,

$$\boxed{A(t)=\begin{bmatrix} a_{11}-\frac{t(a_{11}-1)}{t+1} & \frac{a_{12}}{t+1} & \cdots & \frac{a_{1n}}{t+1} \\ \frac{a_{21}}{t+1} & a_{22}-\frac{t(a_{22}-1)}{t+1} & \cdots & \frac{a_{2n}}{t+1} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{a_{n1}}{t+1} & \frac{a_{n2}}{t+1} & \cdots & a_{nn}-\frac{t(a_{nn}-1)}{t+1} \end{bmatrix}}$$

is the required chain of matrices.

Step-2

Its determinant can be written as follows:

$$\det A=\sum_{\text{all }P\text{'s}}\left(a_{1\alpha}a_{2\beta}\cdots a_{n\nu}\right)\det P$$

Consider the following matrix:

$$A(t)=\begin{bmatrix} a_{11}-\frac{t(a_{11}-1)}{t+1} & \frac{a_{12}}{t+1} & \cdots & \frac{a_{1n}}{t+1} \\ \frac{a_{21}}{t+1} & a_{22}-\frac{t(a_{22}-1)}{t+1} & \cdots & \frac{a_{2n}}{t+1} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{a_{n1}}{t+1} & \frac{a_{n2}}{t+1} & \cdots & a_{nn}-\frac{t(a_{nn}-1)}{t+1} \end{bmatrix}$$