

$$t = 2, 3$$

For $t=2$

$$\begin{pmatrix} -1 & 1 \\ -2 & 2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$\Rightarrow \begin{pmatrix} -1 & 1 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$\Rightarrow -x_1 + x_2 = 0$$

$$\Rightarrow x_1 = x_2$$

$$\therefore X = \begin{pmatrix} 1 \\ 1 \end{pmatrix} x_1$$

$$\therefore X = \left[\begin{pmatrix} 1 \\ 1 \end{pmatrix} \right]$$

For $t=3$

$$\begin{pmatrix} -2 & 1 \\ -2 & 1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$\Rightarrow -2x_1 + x_2 = 0$$

$$\Rightarrow x_2 = 2x_1$$

$$\therefore X = \begin{pmatrix} x_1 \\ 2x_1 \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \end{pmatrix} x_1$$

$$\therefore X = \left[\begin{pmatrix} 1 \\ 2 \end{pmatrix} \right]$$

$$P = \begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix}$$

$$P^{-1} = \begin{pmatrix} 2 & -1 \\ -1 & 1 \end{pmatrix}$$

$$\begin{aligned} P^{-1}AP &= \begin{pmatrix} 2 & -1 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ -2 & 4 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix} = \begin{pmatrix} 4 & -2 \\ -3 & 3 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix} \\ &= \begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix} \end{aligned}$$