

1. Justify whether $\tau = \inf\{s : N_s \geq 2\}$ is a stopping time for the counting process N_t .
2. Let state space $E = \{1, 2\}$ and $P = \begin{bmatrix} 0.5 & 0.5 \\ 0.3 & 0.7 \end{bmatrix}$. Find $P(X_2 = 1, X_7 = 2, X_9 = 2 \mid X_0 = 1)$.
3. For any two integers $n, m \geq 1$ and $i_0, i_1, \dots, i_m \in E$, prove that

$$P(X_{n+1} = i_1, X_{n+2} = i_2, \dots, X_{n+m} = i_m \mid X_n = i_0) = P(i_0, i_1)P(i_1, i_2) \cdots P(i_{m-1}, i_m)$$