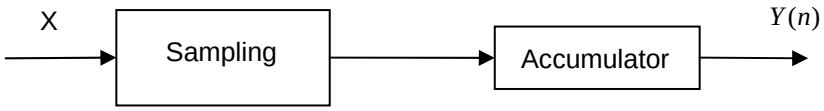
Tutorial 5

1. Suppose random signal $X(t) = V$, V is a uniform distributed random variable between 0 and 1. Is $X(t)$ stationary? Ergodic?

2. $X(n)$ is a first order Markov signal, for any given time $m_1, m_2, m_3 (m_1 < m_2 < m_3)$, the corresponding states are i_1, i_2, i_3 .
   (1) Find the transition probabilities from m_1 *to* m_2 ; m_2 *to* m_3 ; m_1 *to* m_3 separately.
   (2) Derive the relationship between transition probability from m_1 *to* m_3 , m_1 *to* m_2 and m_2 *to* m_3 .

3. $X(t)$ is on-off binary signal, a symbol $S_1(t)$ *or* $S_2(t)$ will be chosen to transmit during every time slot, the corresponding signal magnitudes are 1 and 0 and their chosen probability are P and q . An accumulator $Y(n)$ will add all previous output symbols together ($Y(n) = \sum_{i=1}^{n} X(i)$).



   (1) Derive the state probability $P(Y(n) = k)$
   (2) Derive the transition probability $\pi_{ij}(k, k+5)$

4. For discrete time Markov chain $X(n)$, its transition matrix:

$$P = \begin{bmatrix} 0.7 & ? \\ 0.8 & 0.2 \end{bmatrix}$$

   Define the state probabilities at time 0 as $\pi(0) = (0.5, 0.5)$. Find the state probabilities of $\pi(2)$ and $\pi(3)$.