Stochastic Process

# Probability and Statistics

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| Name | Definition |
| Joint probability distribution | if x nd y are independent |
| Expectation |  |
| Conditional Probability |  |
| Law of total Probability |  |

# Definitions

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| Name | Definition |
| Stochastic Process | A SP is a family of random variables defined on a probability space indexed by parameter t where |
| States | The values of s v/s are called states and set of all possible values of states is called |
| Types of SP | Discrete State, continuous parameter;  Discrete State, discrete parameter;  Continuous State, discrete parameter;  Continuous State, continuous parameter; |
| Markov Inequality | Let , for any positive constant Then |
| Maximal Inequality for non-negative Martingale | Martingale has constant mean, then we can use markov inequality |
| n-step Transition Probability |  |
| Chapman Kolomgrov Equation |  |
| Classification of States | 1. State j is accessible from state i 2. (state I and j communicate) if and 3. Markov chain is irreducible if all states communicate with each other. Otherwise reducible |
| Period of State i | such that |
| Recurrence Time Probability | Probability of first visit of state I in ‘n’ steps |
| Recurrent and Transient States | Recurrent: If i.e return to state ‘i’ is certain  Transient: if return to state i is uncertain. |
| Mean Recurrence time | If then the state i is called recurrent null  If then state I is non-null recurrent or positive recurrent. |
| Mean time at Transient State | Let for expected time periods that a MC is in state j starting from state i  and |
| Conversion of TPM to Q,R,0,1 | Arrange Transient states in 0… r-1 and absorbing states as r…N then.  probability of absorption. Rows represent transient states and Columns represents absorbing states in order of S & R |
| Probability of ever transition | probability that MC will ever make transition into state I from state j |

# Different types of Process

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| Name | Definition |
| Counting Process | X(t)= # of events at time (0,t]   1. X(0)=0 2. S<t X(s) X(t) 3. X(t)-X(s) #of events in (s,t] |
| Independent Increments | Events occurring in disjoint time intervals are independent. are independent |
| Stationary Increments |  |
| Martingales | is a martingale if  And  Martingales have constant means |
| Gambler’s Rum game | Rs to start  Aim=  ith bet st  for time of gambler after n steps/bets |
| 1-D random walk  (here is time to get Rs N, and is the time he gets broke) |  |
| Branching Process  (# of offspring’s of ith individual)  =population will die out if  =Probability that one parent will give birth to j offspring. | when E(=1  If then |
| Poisson Process  =number of events in interval (0,t] & N(a)-N(b)=N(c)-N(d) if a-b=c-d |  |
| Exponential Distribution  :pdf:cdf:Reliability function  : Failure Reliability function |  |
| Interval times and Waiting time distribution  N(t)=#no of events occurring in (0,t]  =time of first arrival  =interval time between n-1th and nth interval  = is the waiting time for nth results | MGF of :  MGF of |

# Important Results

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| Name | Result |
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| Expectation on time periods for transient states | Let N is number of time periods such that a process is in state i starting from state i. |
| Probability of ultimate absorption  State= as transient, as reccurent |  |
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