14 PROBABILITY

1 OMQ + 1 SAQ + 1 LAQ [1 M + 4M +8 M = 13 M]

CONCEPTS & FORMULAS

1. **Random Experiment:** An experiment is said to be a random experiment if
   (i) The outcome of the experiment is never predicted in advance.
   (ii) It had more than one out come.
   (iii) The experiment can be conducted any number of times, under similar conditions.
   Ex: Tossing a coin, rolling two dice at once, drawing a card from a pack of cards, selecting a number from a set of given numbers. etc.,
   Non- Ex: Deterministic experiments like Hitting a ball with a bat, measuring the temperature of a body, the experiments that are conducted in physics labs or chemistry labs etc.,
2. **Sample space (S):** It is the set of all possible outcomes of a random experiment.
   Ex 1: In the random experiment of tossing a coin once, sample space S= {H,T}
   Ex 2: In the random experiment of throwing a die once, sample space S= {1,2,3,4,5,6}
3. **Event (E):** Any subset of the sample space is called an event.
   Ex: When a die is rolled once, the event of getting an odd number is E ={1,3,5}
4. **Elementary Event:** Any outcome of a trial of a random experiment is called an elementary event. The total number of elementary events in S is denoted by n(S).
   Ex 1: If a coin is tossed once then the elementary events are Head (H), Tail (T)
   Hence S={H,T} and n(S) = 2
   Ex 2: If two coins are tossed at a time then S={HH,HT,TH,TT} and $n(S)=2^2=4$
   Ex 3: If an ordinary unbiased fair die is thrown once then S={1,2,3,4,5,6} and n(S)=6
5. **Sure Event:** The event which is sure to happen is called a 'Sure event' or a 'certain event.'
   Ex: Any one of the numbers 1 or 2 or 3 or 4 or 5 or 6 turning up when a die is rolled once.
6. **Impossible Event:** The event which is impossible to happen is called an Impossible event.
   Ex: The number 7 turning up when an ordinary die is thrown, is an impossible event.
7. **Complementary events(E'):** If E is the event of happening of an event then the event of non-happening of the event E is called its complementary event and it is denoted by E' or $\overline{E}$ or E^c
   • Complementary event of E is 'not E'. Also E' = S–E or $E \cup E' = S$
   Ex : Let E be the event of getting an odd number when a die is thrown. Thus E={1,3,5}
   Then its complementary event E' is the event of 'not getting an odd number '.
   Thus, E' is the event of getting an even number and E' ={2,4,6}. Here $E \cup E' = S$
8. **Equally likely events:** Events of a Random experiment are said to be equally likely events if all of them have equal chance of happening.
   Note: The elementary events of a random experiment are always equally likely.
   Ex : In tossing a coin, turning up Head(H) or Tail(T) are equally likely events.
   Non-Ex: Passing or failing in an examination may not be equally likely.

TIT BITS

- Event **A or B** = Set $A \cup B$
- Event **A and B** = Set $A \cap B$
- Event A and not B = Set (A–B)
- P(not A)= P(A')=1–P(A)
- A,B are **Mutually Exclusive** events $\Leftrightarrow$ $A \cap B = \Phi$

9. Favourable Events: The out comes that are **concerned with the happening** of a "given event E " are called Favourable events. The number of favourable events to E is denoted by n(E).

Ex : If two coins are tossed at a time then S={HH,HT,TH,TT} and $n(S)=2^2=4$

Here favourable event to get atleast a head is E={HH, HT, TH} and n(E)=3.

10. Mutually Exclusive events: Events are said to be mutually exclusive (disjoint) if, happening of any one of them prevents the happening of all other events.

No two of them occur atonce. If A and B are mutually exclusive then $A\cap B=\Phi$

Ex : In tossing a coin once, the events of getting H or T are mutually exclusive events.

Non-Ex: When a die is rolled, the sample space is S= {1,2,3,4,5,6}

Now consider the events of

(i) Getting an odd number A = {1,3,5} (ii) Getting an Even number B = {2,4,6}

(iii) Getting an prime number C = {1,3,5}. Here A,B are mutually exclusive as $A\cap B=\Phi$

But A,C are not mutually exclusive as $A\cap C=\{3,5\}\neq\Phi$

11. Exhaustive Events: A set of events is said to be exhaustive if their union results S.

Note: All the elementary events of a random experiment are always exhaustive.

Ex 1: In tossing a coin, turning up Head (H) or Tail (T) are exhaustive events.

Ex 2: When a die is rolled , the sample space S ={1,2,3,4,5,6}.

Let A={1,3,5} and B={2,4,6}. $A\cup B=\{1,3,5\}\cup\{2,4,6\}=\{1,2,3,4,5,6\}$ =S. ∴ A,B are exhaustive

12. Probability of an event: For a finite sample space(S) with equally likely outcomes probability of an event A is $P(A)=\frac{n(A)}{n(S)}$, where n(A)= number of elements in the set A.

13. Axioms of axiomatic definition of probability:

If S is the sample space with out comes $\omega_1, \omega_2, \ldots \omega_n$ then

(i) $P(\omega_i)\geq 0$ and $P(\omega_i)\leq 1$ (or) $0\leq P(\omega_i)\leq 1$ for each $\omega_i\in S$ (Axiom of non-negativity)

(ii) $P(\omega_1)+P(\omega_2)+\ldots\ldots+P(\omega_n)=1$ (or) $\sum_{1}^{n}P(\omega_i)=1$ (or) P(S)=1(Axiom of certainty)

(iii) $P(A)=\sum P(\omega_i)$, $\omega_i\in A$ (Axiom of union)

14. (i) $P(A\cup B)=P(A)+P(B)-P(A\cap B)$ where A, B are any 2 events of sample space S.

(ii) $P(A\cup B)=P(A)+P(B)$ where A, B are mutually exclusive events.

52 cards

2 colours : *26 Red cards* *26 Black cards*

4 suits : *13 hearts (♥)* *(A,2,3,4,5,6,7,8,9,10, J,Q,K)* *13 diamonds (♦)* *(A,2......Q,K)* *13 clubs (♣)* *(A,2,.....Q,K)* *13 spades (♠)* *(A,2,......Q,K)*