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Probability

- **Complement of an event** :

The complement of an event A consists of all those outcomes which are not favorable to the event A, and is denoted by 'not A' or by $\bar{A}$

- **Event 'A or B' :**

The event 'A or B' occurs if either A or B or both occur.

- **Event 'A and B' :**

The event 'A and B' consists of all those outcomes which are favorable to both the events A and B.

- **Addition Law of Probability:**

For any two events A and B of a sample space S
P (A and B) – P (A ∪B) = P (A) + P (B)

- **Additive Law of Probability for Mutually Exclusive Events :**

If A and B are two mutually exclusive events, then

$P\ (A\ or\ B) = P\ (\ A \cup B)$= P (A) + P (B)

- **Odds in Favour of an Event :**

If the odds for A are a to b, then

$$P\ (A) = \frac{a}{a+b}$$

odds against A are a to b, then b

$$P\ (A) = \frac{b}{a+b}$$

Two events are mutually exclusive, if occurrence of one precludes the possibility of simultaneous occurrence of the other.

Two events are independent, if the occurence of one does not affect the occurence of other. If A and B are independent events, then P (A and B) = P (A). P (B) or $P(A\ \cap B) =\ P(A).P(B)$

- **For two dependent events**

$P(A \cap B) = P(A).P\left(\frac{B}{A}\right)$, P(A) >0

$P(B \cap A) = P(B).P\left(\frac{A}{B}\right)$, P(B) >0

- **Conditional Probability**

$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)}$$

$$P\left(\frac{B}{A}\right) = \frac{P(A \cap B)}{P(A)}$$

- **Theorem of Total Probability**

$$P(A) = P(E_1).P\left(\frac{A}{E_1}\right) + P(E_2).P\left(\frac{A}{E_2}\right) +. \dots P(E_N).P\left(\frac{A}{E_N}\right)$$

- **Baye's Theorem:**

If $B_1, B_2, B_3 \ldots . B_N$ are mutually exclusive events and A is any event that occurs with B_1 or B_2 or B_N

$$P\left(\frac{B_i}{A}\right) = \frac{P(B_i).P\left(\frac{A}{B_i}\right)}{\sum_{i=1}^{n} P(B_i).P\left(\frac{A}{B_i}\right)}, \text{ i=1,2,3…n}$$

Mean and Variance of a Random Variable

$$\mu = E(x) = \frac{n}{z} X_i P_i$$

$$\sigma^2 = \frac{n}{z}(x_i - \mu)^2 = \frac{n}{z} {x_i}^2 P_i - \mu^2$$

Binomial Distribution

P(x=r)=$n_{C_r} P^r q^{n-r}$

Check Your Progress

1. There are 13 men and 2 women in a party. They are seated round a circular table. The probability that the two women will sit together is-
   (A) 2/105 (B) 1/105
   (C) 1/14 (D) 1/7
2. A bag contains two pairs of shoes. Two shoes are drawn from it. The probability that it is a pair is-
   (A) 1/3 (B) 1/2
   (C) 1/4 (D) 2/3
3. If out of 20 consecutive whole numbers two are chosen at random, then the probability that their sum is odd, is-
   (A) 5/19 (B) 10/19
   (C) 9/19 (D) None of these
4. If the probabilities of boy and girl to be born are same, then in a 4 children family the probability of being at least one girl, is-
   (A) 14/16 (B) 15/16
   (C) 1/8 (D) 3/8
5. If 4 cards are drawn one by one from a pack of 52 cards, the probability that one will be from each suit, is-
   (A) $\frac{13}{52} \times \frac{13}{39} \times \frac{13}{26} \times \frac{13}{13}$
   (B) $\frac{13}{52} \times \frac{13}{51} \times \frac{13}{50} \times \frac{13}{49} \times 24$
   (C) $\frac{13}{52} \times \frac{13}{39} \times \frac{13}{26} \times \frac{13}{13} \times 24$
   (D) $\frac{13}{52} \times \frac{13}{51} \times \frac{13}{50} \times \frac{13}{49}$
6. The probability that two persons have same date of birth is (in non-leap year)
   (A) 0 (B) 1
   (C) 1/365 (D) 364/365
7. Two coins are tossed together. The probability of getting two heads is-
   (A) 1/2 (B) 1/4
   (C) 1/8 (D) 1/3
8. Let P(A) = 0.4 & P(B/A) = 0.5. The probability P($\overline{A} \cup \overline{B}$) is equal to-
   (A) 0.8 (B) 0.7
   (C) 0.6 (D) None of these
9. A pair of dice is thrown. If 5 appears on at least one of the dice, then the probability that the sum is 10 or greater, is-
   (A) 11/36 (B) 2/9
   (C) 3/11 (D) 1/12
10. A pair of dice is thrown. If the two numbers appearing on them are different, the probability that the sum is 6, is-
    (A) 2/15 (B) 1/9
    (C) 5/36 (D) 1/12
11. Two dice are thrown together. If 3 appears on at least one of the dice, then what is the probability that the sum is greater than 9
    (A) 1/4 (B) 3/11
    (C) 5/11 (D) zero
12. In a certain town, 40% of the people have brown hair, 25% have brown eyes and

15% have both brown hair and brown eyes. If a person selected at random has brown hair, the probability that he also has brown eyes is-

(A) 2/5 (B) 1/4

(C) 1/2 (D) 3/8

13. A bag contains 7 red and 3 black balls. Three balls are drawn at random from the bag one after the other. The probability that the first two are red and the third is black is-

    (A) 21/40 (B) 1/5
    (C) 7/50 (D) 7/40

14. For two given events A and B, the relation P (AB) = P(A) P(B) implies that A and B are-

    (A) independent
    (B) mutually exclusive
    (C) dependent
    (D) None of these

15. A man is known to speak the truth 3 out of 4 times. He throws a die and reports that it is a six. The probability that it is actually a six, is-

    a. (A) 3/8 (B) 1/5
    b. (C) 3/4 (D) None of these

Stretch Yourself

1. A bag A contains 2 white and 3 red balls and bag B contains 4 white and 5 red balls. One ball is drawn at random from a randomly chosen bag and is found to be red. Find the probability that it was drawn from bag B .
2. A man is known to speak the truth 3 out of 4 times. He throws a die and reports that it is a six. What is the probability that it is actually a six.
3. A coin is tossed three times. What is the probability of getting all heads or tails only.

Hint to Check Your Progress

1 D	2 A	3 B	4 B	5 B
6 C	7 B	8 A	9 C	10 A
11D	12 D	13 D	14 A	15 C