Tender Heart High School, Sector 33 B, Chandigarh
Class : 10th
Date : 4-11-2024
Subject : Mathematics
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# Chapter- 27 Probability

## Introduction :-

Consciously or unconsciously, all of us sometime use the phrases like 'most likely', 'almost uncertain', 'most probably', 'no chance' etc.
All of the above involve an element of uncertainty. The measure of uncertainty is called the theory of probability.

Some terms related to probability

* **Experiment** :- An action which results in some (well-defined) outcomes is called an experiment.

* **Random experiment** :- If it has more than one possible outcome and it is not possible to predict the outcome in advance.

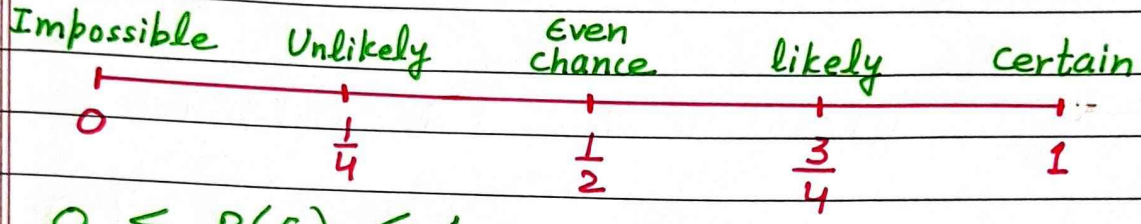
**Examples** :-

1) tossing a coin
2) throwing a die
3) drawing a card from a pack of 52 (playing) cards.

* **Sample space** :- The collection of all possible outcomes of an experiment is called sample space.

* **Event** :- A subset of the sample space associated with a random experiment is called an event.

## Probability Scale




$0 \leq P(E) \leq 1$

$P(E) + P(\bar{E}) = 1$

The probability of the happening of an event 'E', denoted by P(E), is defined as

$$P(E) = \frac{\text{Number of favourable outcomes}}{\text{Total number of possible outcomes}}$$

## Probability Definition in Mathematics

Probability is a measure of the likelihood of an event to occur. Many events cannot be predicted with total certainty. We can predict only the chance of an event to occur that is how likely they are to happen using it. Probability can range in from 0 to 1, where 0 means the event to be an impossible one and 1 indicates a certain event.

## Example 1

Find the probability of getting a head when a coin is tossed once.

Also find the probability of getting a tail.

Total number of outcomes

= 2 (either Heads or Tails)

**Tails** **Heads**

Number of outcomes in which head comes = 1

$$\textbf{P(getting a Head)} = \frac{Number\ of\ outcomes\ in\ which\ head\ comes}{Total\ Number\ of\ outcomes}$$

$$= \frac{1}{2}$$

Number of outcomes in which tail comes = 1

$$\textbf{P(getting a Tail)} = \frac{Number\ of\ outcomes\ in\ which\ tail\ comes}{Total\ Number\ of\ outcomes}$$

$$= \frac{1}{2}$$

**Cards (52)**

| Spade | Club | Diamond | Heart |
|---|---|---|---|
| 1 King | 1 King | 1 King | 1 King |
| 1 Queen | 1 Queen | 1 Queen | 1 Queen |
| 1 Jack | 1 Jack | 1 Jack | 1 Jack |
| 1 Ace | 1 Ace | 1 Ace | 1 Ace |
| 2-10 Cards | 2-10 Cards | 2-10 Cards | 2-10 Cards |
| **Total** = 13 | **Total** = 13 | **Total** = 13 | **Total** = 13 |

II Throwing a Die ⟶ A die is a solid cube having 6 faces marked 1, 2, 3, 4, 5 and 6 or having 1, 2, 3, 4, 5, 6 dots.

In throwing a die, the outcome is the number or number of dots appearing on the uppermost face.

The plural of die is dice.

When a die is thrown, we have

Sample space, $S = \{1, 2, 3, 4, 5, 6\}$ ; $n(S) = 6$

In rolling (throwing) two dice simultaneously

Possible outcomes are:-

$$\left\{\begin{array}{l} (1,1), (1,2), (1,3), (1,4), (1,5), (1,6) \\ (2,1), (2,2), (2,3), (2,4), (2,5), (2,6) \\ (3,1), (3,2), (3,3), (3,4), (3,5), (3,6) \\ (4,1), (4,2), (4,3), (4,4), (4,5), (4,6) \\ (5,1), (5,2), (5,3), (5,4), (5,5), (5,6) \\ (6,1), (6,2) (6,3), (6,4), (6,5), (6,6) \end{array}\right\}$$

$n(S) = 6 \times 6 = 36$

Example :- A die is thrown once. What is the probability of getting

1) an even number  2) prime number

Solution:- $P(E) = \frac{\text{Favourable outcomes}}{\text{Total no. of outcomes}}$

Sample space $= \{1, 2, 3, 4, 5, 6\}$ , $n(S) = 6$

1) Even numbers $= \{2, 4, 6\}$ = , $n(E_1) = 3$

$P(\text{even no.}) = \frac{3}{6} = \frac{1}{2}$

Example :-

Let $E_1$ be the event of getting a doublet

Then, $E_1 = \{(1,1), (2,2), (3,3), (4,4), (5,5), (6,6)\}$

$n(E_1) = 6$

So, $P(\text{getting a doublet}) = \frac{n(E_1)}{n(S)} = \frac{6}{36} = \frac{1}{6}$

## Multiple Choice Questions

*Choose the correct answer from the given four options (1 to 21):*

1. Which of the following cannot be the probability of an event?

   (*a*) 0·7 (*b*) $\frac{2}{3}$ (*c*) −1·5 (*d*) 15%

2. If the probability of an event is $p$, then the probability of its complementary event will be

   (*a*) $p - 1$ (*b*) $p$ (*c*) $1 - p$ (*d*) $1 - \frac{1}{p}$

3. Out of one digit prime numbers, one number is selected at random. The probability of selecting an even number is

   (*a*) $\frac{1}{2}$ (*b*) $\frac{1}{4}$ (*c*) $\frac{4}{9}$ (*d*) $\frac{2}{5}$

4. When a die is thrown, the probability of getting an odd number less than 3 is

   (*a*) $\frac{1}{6}$ (*b*) $\frac{1}{3}$ (*c*) $\frac{1}{2}$ (*d*) 0

5. The probability of getting a number divisible by 3 in throwing a die is

   (*a*) $\frac{1}{6}$ (*b*) $\frac{1}{3}$ (*c*) $\frac{1}{2}$ (*d*) $\frac{2}{3}$ (2022)

6. A fair die is thrown once. The probability of getting an even prime number is

   (*a*) $\frac{1}{6}$ (*b*) $\frac{2}{3}$ (*c*) $\frac{1}{3}$ (*d*) $\frac{1}{2}$

7. A fair die is thrown once. The probability of getting a composite number is

   (*a*) $\frac{1}{3}$ (*b*) $\frac{1}{6}$ (*c*) $\frac{2}{3}$ (*d*) 0

8. If a fair die is rolled once, then the probability of getting an even number or a number greater than 4 is

   (*a*) $\frac{1}{2}$ (*b*) $\frac{1}{3}$ (*c*) $\frac{5}{6}$ (*d*) $\frac{2}{3}$

9. If a letter is chosen at random from the letters of English alphabet, then the probability that it is a letter of the word 'DELHI' is

   (*a*) $\frac{1}{5}$ (*b*) $\frac{1}{26}$ (*c*) $\frac{5}{26}$ (*d*) $\frac{21}{26}$

10. A card is selected at random from a pack of 52 cards. The probability of its being a red face card is

    (*a*) $\frac{3}{26}$ (*b*) $\frac{3}{13}$ (*c*) $\frac{2}{13}$ (*d*) $\frac{1}{2}$

11. If a card is drawn from a well-shuffled pack of 52 playing cards, then the probability of this card being a king or a jack is

    (*a*) $\frac{1}{26}$ (*b*) $\frac{1}{13}$ (*c*) $\frac{2}{13}$ (*d*) $\frac{4}{13}$

12. The probability that a non-leap year selected at random has 53 Sundays is

    (*a*) $\frac{1}{365}$ (*b*) $\frac{2}{365}$ (*c*) $\frac{2}{7}$ (*d*) $\frac{1}{7}$

13. A bag contains 3 red balls, 5 white balls and 7 black balls. The probability that a ball drawn from the bag at random will be neither red nor black is

    (*a*) $\frac{1}{5}$ (*b*) $\frac{1}{3}$ (*c*) $\frac{7}{15}$ (*d*) $\frac{8}{15}$

14. A bag contains 4 red balls and 5 green balls. One ball is drawn at random from the bag. The probability of getting either a red ball or a green ball is

(a) $\frac{4}{9}$ (b) $\frac{5}{9}$ (c) 0 (d) 1

15. One ticket is drawn at random from a bag containing tickets numbered 1 to 40. The probability that the selected ticket has a number which is a multiple of 5 is

(a) $\frac{1}{5}$ (b) $\frac{3}{5}$ (c) $\frac{4}{5}$ (d) $\frac{1}{3}$

16. If a number is randomly chosen from the numbers 1, 2, 3, 4, ....., 25, then the probability of the number to be prime is

(a) $\frac{7}{25}$ (b) $\frac{9}{25}$ (c) $\frac{11}{25}$ (d) $\frac{13}{25}$

17. A box contains 90 cards numbered 1 to 90. If one card is drawn from the box at random, then the probability that the number on the card is a perfect square is

(a) $\frac{1}{10}$ (b) $\frac{9}{100}$ (c) $\frac{1}{9}$ (d) $\frac{3}{100}$

18. If a (fair) coin is tossed twice, then the probability of getting two heads is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{3}{4}$ (d) 0

19. If two coins are tossed simultaneously, then the probability of getting atleast one head is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{3}{4}$ (d) 1

20. Lakshmi tosses two coins simultaneously. The probability that she gets atmost one head is

(a) 1 (b) $\frac{3}{4}$ (c) $\frac{1}{2}$ (d) $\frac{1}{7}$

21. The probability of getting a bad egg in a lot of 400 eggs is 0·035. The number of bad eggs in the lot is

(a) 7 (b) 14 (c) 21 (d) 28

## Summary

- Probability is a measure of uncertainty.
- The probability of an event E, written as P(E) is defined as

$$P(E) = \frac{\text{number of outcomes favourable to E}}{\text{total number of possible outcomes}}$$

where we assume that all the outcomes of the experiment are equally likely.

- The probability of an event E is a number P(E) such that $0 \le P(E) \le 1$.
- The probability of a sure event (or a certain event) is 1.
- The probability of an impossible event is 0.
- An event which has only one (favourable) outcome from the sample space is called an elementary event.
- The sum of probabilities of all elementary events of an experiment is 1.
- If E is an event, then the event 'not E' is complementary event of E, and complementary event of E is denoted by $\bar{E}$ or $E^c$ 'or E'.
- For any event E, we have
  - (i) $P(\bar{E}) = 1 - P(E)$
  - (ii) $P(E) = 1 - P(\bar{E})$
  - (iii) $P(E) + P(\bar{E}) = 1$.