

Probability

1. What is probability in statistics? Explain with a real-life example like predicting rain.

Probability in statistics is the measure of how likely an event is to occur, expressed between 0 and 1 (or 0% to 100%).

Example: Predicting rain

If the weather forecast says there's a 70% chance of rain tomorrow, it means that out of 100 similar days with the same conditions, it rained on about 70 of them.

2. Define a random experiment. Give one example involving a coin or dice.

A random experiment is an action or process that leads to an outcome which cannot be predicted with certainty in advance.

Example: Tossing a coin — the outcome (Head or Tail) is uncertain until the coin lands.

3. What is a sample space? Write the sample space for rolling a 6-sided die.

A sample space is the set of all possible outcomes of a random experiment.

Example (6-sided die):

$S = \{1, 2, 3, 4, 5, 6\}$

4. What is a favorable outcome in probability? Explain using an example of drawing a red ball from a bag.

A favorable outcome is the specific result (or results) that match the event we are interested in.

Example: If a bag has red and blue balls, and we want the probability of drawing a red ball, then drawing a red ball is the favorable outcome.

5. Define theoretical (classical) probability. How would you use it to calculate the chance of heads in a coin toss?

Theoretical (classical) probability is based on the assumption that all outcomes are equally likely.

Example (coin toss):

- Possible outcomes = {Head, Tail} $\rightarrow 2$
- Favorable outcomes for Head = 1
- Probability = $1 / 2 = 0.5$ or 50%

6. What is empirical probability? How can it be applied in sports performance data?

Empirical probability is calculated from actual observations or experiments, not assumptions.

Example (sports): If a basketball player makes 60 shots out of 100 attempts, the empirical probability of scoring is $60/100 = 0.6$ (60%).

7. What is the difference between an event and an outcome in probability?

- An outcome is a single possible result of an experiment.
- An event is a set of one or more outcomes that we are interested in.

Example (dice):

- Outcome: rolling a 4.
- Event: rolling an even number $\{2, 4, 6\}$.

8. If a bag contains 3 red, 2 green, and 5 blue balls, what is the probability of picking a green one?

Total balls = $3 + 2 + 5 = 10$

Green balls = 2

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

9. What does it mean if two events are mutually exclusive? Give an example involving a standard die.

Two events are mutually exclusive if they cannot happen at the same time.

Example (die): Rolling a 3 and rolling a 6 in the same toss are mutually exclusive — only one outcome can occur.

10. Define independent events with a real-life example such as flipping two coins.

Independent events are events where the outcome of one does not affect the outcome of the other.

Example: Flipping two coins — the result of the first coin (Head/Tail) does not affect the result of the second coin.

11. What is the probability of drawing a king from a standard deck of cards?

Formula:

Probability = (Favorable outcomes) / (Total outcomes)

Solution (King in 52 cards):

= 4 / 52

= 1 / 13

≈ 0.0769 or 7.69%

12. If the probability of it raining tomorrow is 0.3, what is the probability it will not rain?

Formula:

Probability (Not Event) = 1 – Probability (Event)

Solution:

= 1 – 0.3

= 0.7

The probability it will not rain is 0.7 (70%).

13. Why must probability always lie between 0 and 1?

Because probability shows the **likelihood of an event**, it cannot be less than **0** (impossible) or more than **1** (certain).

So, probability always lies between 0 and 1.

14. How does probability help in real-life decisions such as medical testing or quality control?

Probability helps in making informed decisions under uncertainty.

- Medical testing: Doctors use probability to judge the chance that a patient has a disease based on test results.
- Quality control: Manufacturers use probability to estimate the chance of defects and decide if a batch of products is acceptable.

15. What is the probability of getting an even number when rolling a die? Justify your answer.

Formula:

Probability = (Favorable outcomes) / (Total outcomes)

Solution:

Even numbers on a die = $\{2, 4, 6\} \rightarrow 3$ outcomes

Total outcomes = 6

Probability = $3 / 6 = 1 / 2 = 0.5$ (50%) ✓

Justification: Half of the numbers on a die are even.