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Basic Concepts of Probability

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Probability is defined as the likelihood of the occurrence of any event. Probability is expressed as a number between 0 and 1, where, 0 is the probability of an impossible event and 1 is the probability of a sure event.
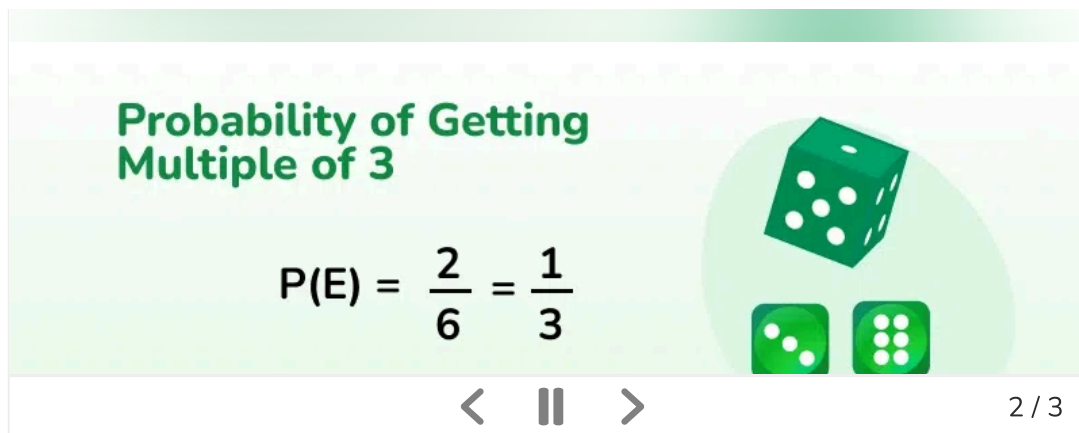
Concepts of Probability are used in various real life scenarios :

- *Stock Market : Investors and analysts often study these parameters and use probabilistic models to understand trends and patterns for the movement of stock price.*
- *Insurance: Insurance companies use probability models to estimate the likelihood of various events to manage this risk, and set premiums accordingly.*
- *Weather Forecasting : Meteorologists use probability to predict the likelihood of various weather events, such as rain, snow, storms, or temperature changes.*

Probability of an Event

The probability of an event E, denoted by P(E), is a number between 0 and 1 that represents the likelihood of E occurring.

- If P(E) = 0, the event E is impossible.
- If P(E) = 1, the event E is certain to occur.
- If 0 < P(E) < 1, the event E is possible but not guaranteed.

Note: *The sum of the probabilities of all events in a sample space is always equal to 1.*

For example: When we toss a coin, there are only two possible outcomes: Heads (H) or Tails (T). However, if we toss two coins simultaneously, there will be four possible outcomes: (H, H), (H, T), (T, H), and (T, T).

Sample Space and Event

- **Sample Space and Events Sample Space**: The sample space, often denoted by S, is the set of all possible outcomes of an experiment. **For example,** when rolling a six-sided die, the sample space is S = {1, 2, 3, 4, 5, 6}.

- **Event**: An event is any subset of the sample space. It represents a specific outcome or a combination of outcomes. There are many different types of events in Probability such as Impossible and Sure Events, Mutually Exclusive Events, Exhaustive Events, Dependent and Independent Events et. **For example,** rolling an even number E = {2, 4, 6}) is an event in the context of rolling a die.

Formula for Probability

Probability formula is defined as the ratio of the number of favorable outcomes and the total number of outcomes.

Basic Probability Rules

- **Addition Rule**: P(A∪B) = P(A) + P(B) - P(A∩B), where A∪B denotes the union of events A and B.

- **Multiplication Rule for Independent Events: P(A∩B) = P(A) × P(B)**, where A and B are independent events.

- **Complement Rule**: P(A ') = 1 - P(A), where ' A ' denotes the complement of event A.

Applications of Probability

Some of the common events which we can use applications of probability to check the results are:

- Choosing a card from the deck of cards
- Flipping a coin
- Throwing a dice in the air
- Pulling a red ball out of a bucket of red and white balls
- Winning a lucky draw

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  - *Practice Problems on Probability*

Basic Concepts of Probability - Examples

Example 1: There are 6 pillows in a bed, 3 are red, 2 are yellow and 1 is

Probability is equal to the number of yellow pillows in the bed divided by the total number of pillows, i.e.

2/6 = 1/3

Example 2: There is a container full of coloured bottles, red, blue, green and orange. Some of the bottles are picked out and displaced. Sumit did this 1000 times and got the following results:

- **No. of blue bottles picked out: 300**
- **No. of red bottles: 200**
- **No. of green bottles: 450**
- **No. of orange bottles: 50**

a) What is the probability that Sumit will pick a green bottle?

For every 1000 bottles picked out, 450 are green.

Therefore,

P(green) = 450/1000 = 0.45

b) If there are 100 bottles in the container, how many of them are likely to be green?

Out of 100 bottles, 45 are green.

Example 3: Find the probability of 'getting 3 on rolling a die'.

Solution:

> *Sample Space = S = {1, 2, 3, 4, 5, 6}*
>
> *Total number of outcomes = n(S) = 6*
>
> *Let A be the event of getting 3.*
>
> *Number of favorable outcomes = n(A) = 1*
>
> *i.e. A = {3}*
>
> *Probability, P(A) = n(A)/n(S) = 1/6*
>
> *Hence, P(getting 3 on rolling a die) = 1/6*

Example 4: A vessel contains 4 blue balls, 5 red balls and 11 white balls. If three balls are drawn from the vessel at random, what is the probability that the first ball is red, the second ball is blue, and the third ball is white?

Solution:

> *Probability to get the first ball is red or the first event is 5/20*
>
> *Since we have drawn a ball for the first event to occur, then the number of possibilities left for the second event to occur is 20 − 1 = 19*
>
> *Hence, the probability of getting the second ball as blue or the second event is 4/19*
>
> *Again with the first and second event occurring, the number of possibilities left for the third event to occur is 19 − 1 = 18*
>
> *And the probability of the third ball is white or the third event is 11/18*
>
> *Therefore, the probability is 5/20 x 4/19 x 11/18 = 44/1368 = 0.032*
>
> *We can express it as: P = 3.2%.*

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