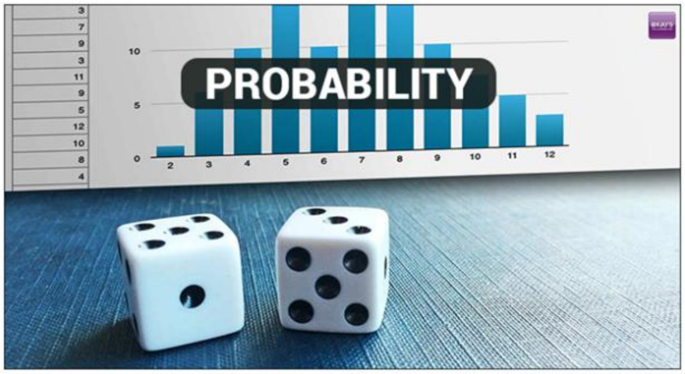
Probability



Probability is the measure of the likelihood of an event to occur. Many events cannot be predicted with total certainty. We can predict only the chance of event to occur, how likely they are to happen, using probability.

Probability can range in between 0 to 1, where 0 probability means the event to be an impossible one and probability 1 indicates the certain event.

The Line of Probability-

General Probability Formula-

$$Probability\ of\ event\ to\ happen\ P(E) = \frac{Number\ of\ favourable\ outcome}{Total\ Number\ of\ outcomes}$$

General Terms Related To Probability

Sample Space- The set of all the possible outcomes to occur in any trial is known as sample space.

Examples-

Tossing a coin, Sample Space (S) = $\{H, T\}$

Rolling a die, Sample Space (S) = $\{1, 2, 3, 4, 5, 6\}$

Sample Space is made up of Sample Points:

Sample Point- It is one of the possible results

Examples- Deck of Cards

- 4 of hearts is a sample point
- the queen of Clubs is a sample point

"Queen" is not a sample point. As there are four Queens i.e. four different sample points.

Experiment or Trial- It is a series of action where the outcomes are always uncertain.

Examples- Tossing of a coin, Selecting a card from deck of cards, throwing a dice.

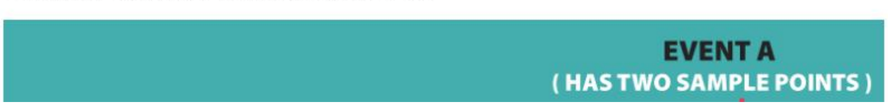
Event- It is a single outcome of an experiment.

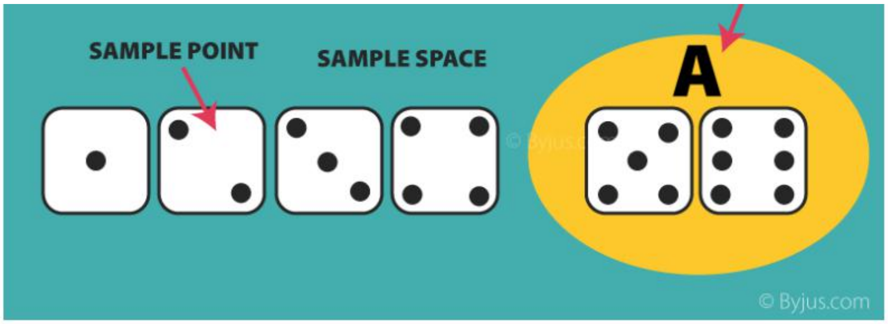
Examples Events-

- Rolling a "1" is an event
- Getting a Heads while tossing a coin is an event.

An event can have one or more than one possible outcomes:

- An event can be Getting a "Jack" from a deck of cards (out of 52 cards, any of the 4 Jack)
- Rolling an "odd number" (1, 3 or 5) is also an event.





Note- The probability of all the events in a sample space sums up to 1.

Lets Work Out-

Example- Find the probability of rolling a '3 with a die.'

Solution- The sample space for the event is $= \{1, 2, 3, 4, 5, 6\}$

Number of favourable event = 1

Total number of outcomes = 6

Thus Probability = $\frac{1}{6}$

Example- One card is drawn at random from a pack of cards. What is the probability that the card drawn is a face card (Jack, Queen and King only)?

Solution- We know that the card has 52 cards.

Thus a total number of outcomes = 52.

Number of favourable event= 4×3

Probability = $\frac{Number\ of\ favourable\ outcome}{Total\ Number\ of\ outcomes} = \frac{12}{52}$

= $\frac{3}{13}$

Conditional Probability-

Consider an example of tossing three coins, the sample space for this trial would be-

$S = \{HHH, HHT, HTH, THH, TTH, THT, HTT, TTT\}$

Since all the events are fairly likely to occur. Thus the probability of each sample event will be $\frac{1}{8}$.

Let **E** be the event such that, **"At Least two heads occur"** and another event **F** such that **"First coin shows tails."**

E = $\{HHT, HTH, THH, HHH\}$

F = $\{THH, THT, TTH, TTT\}$

P(E)= $P\{HHT\} + P\{HTH\} + P\{THH\} + P\{HHH\}$

P(F)= $P\{THH\} + P\{THT\} + P\{TTH\} + P\{TTT\}$

We know the probability of each event to occur is $\frac{1}{8}$

P(E) = $\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{1}{2}$

P(F) = $\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{1}{2}$

$E \cap F = \{THH\}$

$P(E \cap F) = P\{THH\} = \frac{1}{8}$

Now if we consider event F occurs first then what is the probability of occurrence of event E?

This is the case of Conditional Probability.

With the information of occurrence of F, we are sure that the case in which first coin does not result into a tail should not be considered while finding the probability of E. Thus this reduces our sample space S to its subsets F for the event E.

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Now sample point of event F which is favourable to event E is THH.

Thus **Probability of event E given that event F has already occurred** $P(E/F)$ **=** $\frac{1}{4}$.

$P(E/F) = \frac{Probability\ of\ elementary\ events\ favourable\ to E \cap F}{Number\ of\ elementary\ events\ which\ are\ favourable\ to\ F}$

$P(E/F) = \frac{n(E \cap F)}{n(F)}$<

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