Some Topics Related with Probability

Experiment: An experiment is an act that can be repeated under some given conditions.

Example: Throwing a fair coin or a fair die.

Random Experiment: A random experiment is an experiment that can be repeated any number of times under some identical conditions.

In any random experiment the outcome of any particular trial should not be known beforehand. But all possible outcome should be known in advance.

Example: (i) Tossing a fair coin or throwing a die and observe what the top shows.

(ii) The numbers of road accidents per day in Dhaka city.

Trial: ~~Any~~ ~~possible~~ ~~outcome or a set of~~ ~~possible~~ ~~outcomes of a~~ Consider an experiment which though repeated under essentially identical conditions, does not give unique results but may result in any one of the several possible

Example: Throwing of a die in a trial.

Event: Any possible outcome or a set of possible outcomes of a random experiment is called an event.

Generally, events be denoted by capital letter A, B, C, D etc.

Example: If the sample space of drawn an unbiased die is S: {1, 2, 3, 4, 5, 6} and the set of odd number is denoted by A: {1, 3, 5}. Then A is an event of the obtained odd numbers in sample space.

Simple event: When an event corresponds to a single possible outcome then it is called simple (or elementary) event.

For example, in case of rolling a die, to have two-dot is a simple event.

Compound (Composite event): When an event corresponds to a set of possible outcomes then it is known as compound event.

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For example, in case of rolling a die, to have two dots, four dot and six dot is a composite event.

Certain (Sure) event: An event whose occurance is a must in any random experiment is known as a certain event.

Example: To die for every living is a certain event.

Impossible event: An event whose occurance is quite impossible in a random experiment is called an impossible event.

Example: To live without breathing is an impossible event.

Equally likely events: The outcomes of a trial or experiment are said to be equally likely if each of them have equal chance to be occured.

Example: In case of tossing a fair coin head and tail are equally likely events.

can not happen at the same time

Mutually Exclusive Events:

If the happening of any of the events excludes the happening of all the others then the events (or cases) would be termed as mutually exclusive events.

Example: If a die is thrown up then any of the six possible outcomes will appear. In this case more than one outcome can not appear at the same time.

Non-mutually exclusive events:

When two or more events have have common elements in random experiment then these are called non-mutually exclusive events.

In others words, the two event A and B are called non mutually exclusive if $A \cap B \neq \varphi$ In this case, $P(A \cap B) \neq 0$

Example: If $A = \{2, 4, 6\}$ and $B = \{3, 6\}$, then A and B are non mutually exclusive events.

Exhaustive Events:

The total numbers of all possible outcomes of a random experiment is known as exhaustive events.

for example, the numbers of all possible outcomes, in case of throwing die 1, 2, 3, 4, 5 and 6 create an exhaustive events.

Independent Events: If the occurance of a set of events

→ occurrence of one event does not influence / influenced by the other event

is not affected by any other events in any way, then the set of events is known as independent events.

for example, if we throw die three times, the results of the 1st draw, 2nd draw and 3rd would be independent of each other.

Dependent Events: If the occurance or non-occurance of an event in a trial is affected by the other subsequent trials then the events are said to be dependent events.

for example, if we consider balls in a box where 5 are red, then the probability of drawing a red ball in the 1st draw is $\frac{5}{10}$. If we are not return the ball back then the probability of drawing a red ball in the second draw is $\frac{4}{9}$.

Complementary Events: The complement of an event implies the non-occurance of the event.

Therefore, the complement of an event E contains ~~to~~ those points of the sample space which are not in E.

The complement of event E is denoted by $\bar{E}$.

Both E and $\bar{E}$ are complement of each othero.

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

or, $$P(\bar{E}) = 1 - P(E)$$

Sample space: The set or collection of all possible outcomes of a random experiment is known as sample space. It is usually denoted by capital letters. And each and every possible outcome in the sample space is called sample point.

Example: If we considers the experiment with throwing a die, then the sample space $S = \{1, 2, 3, 4, 5, 6\}$ and each of 1, 2, 3, 4, 5, 6 is known as sample point.

Favourable outcomes : The numbers of outcomes that results the happening of all desired event are known as favourable outcomes of that event.

For example, if we have 10 balls in a box of which 5 are red then the favourable outcomes of getting a red ball is 5.

Null event : An event having no sample point is called a null event and is denoted by φ.

Different Approaches of Probability

- Classial (or priori) approach
- Relative or Emperical approach
- Axiomatic approach

Classical or Priori approach:

The probability of an event

$$P = \frac{\text{Numbers of favourable outcome}}{\text{Total numbers of possible outcome}}$$

Consider that in an experiment the event A contain $n(A)$ of these (that is favourable) outcomes, then the probability of A is given by $P(A) = \frac{n(A)}{n(S)}$, where $n(S)$ is the total numbers of outcomes.

Example: If we want to know the probability of getting a King in a draw from a pack of 52 cards, then total numbers of cases (or outcomes)

$n(S) = 52$.

Total numbers of Kings, $n(A) = 4$.

where A is the event of getting a King.

$$\therefore P(A) = \frac{n(A)}{n(S)} = \frac{4}{52} = \frac{1}{13}$$

Meaning of $P(A)=0$ and $P(A)=1$.

Let A be an event belongs to the sample space S in random experiment E.

Suppose, the sample space S contains $n(S)$ occurrences of which $n(A)$ occurrences belong to the event A.

According to the definition of priori probability, we have.

$$P(A) = \frac{n(A)}{n(S)}$$

Now, $P(A) = 0$

$$\Rightarrow \frac{n(A)}{n(S)} = 0$$

$$\therefore n(A) = 0$$

That is there is no element in event A.

So A is an impossible event.

Again, $P(A) = 1$.

$$\Rightarrow \frac{n(A)}{n(S)} = 1$$

$$\therefore n(A) = n(S)$$

That is, the total numbers of elements of event A and the sample space are equal.

So A is a certain event.