Probability

If an experiment is performed repeatedly under essentially homogeneous and similar conditions, the result or outcome may be classified as follows:

- It is unique or certain (known as deterministic or predictable phenomena.)

  Ex: If dilute sulphuric acid is added to zinc, we get hydrogen.

- It is not definite by may be one of the various possibilities depending on the experiment (known as deterministic or predictable phenomena.)

  Ex: A producer cannot ascertain the future demand of his product with certainty.

A numerical measure of uncertainty is provided by a very important branch of statistics called the "Theory of probability".

- The theory of probability has its origin in the games of chance related to gambling, for instance, throwing of dice or ~~origin~~ coin, drawing cards from a pack of cards and so on.
- Jeorome Cardan (1501 - 1576) an italian mathematician was the first man to write a book on the subject entitled "Book on Games of chance".

Terminology:

(1) Random Experiment:

An experiment is called as random experiment if when conducted repeatedly under essentially homogeneous conditions, the result is not unique but may be any of the various possible outcomes.

(2) Trail and Event:

Performing of a random experiment is called a trail and outcome or combinations of outcomes are termed as events.

Ex: If a coin is tossed repeatedly, the result is not unique. We may get any of the two faces head or tail. Thus tossing a coin is a random experiment or trail and getting of a head or tail is an event.

Event is called simple if it corresponds to a single possible outcome of the experiment or trail otherwise it is known as a compound or composite event.

(3) Exhaustive Cases:

The total number of possible outcomes of a random experiment is called the exhaustive cases for the experiment.

(4) Favorable cases or events:

The number of outcomes of a random experiment which entail (or result in) the happening of an event are termed as the cases of favourable to the event.

Ex: In a toss of two coins, the number of cases favourable to the event 'exactly one head' is 2 viz. HT, TH.

(5) Mutually Exclusive Events or cases:

Two or more events are said to be mutually exclusive if the happening of any one of the them excludes the happening of all others in the same experiment.

Ex: In toss of a coin the events head and tail are mutually exclusive because if head comes, we can't get tail and if tail comes we can't get head.

(6) Equally Likely Cases:

The outcomes are said to be equally likely or equally probable if none of them is expected to occur in preference to other.

Ex: In tossing of a coin, all the ~~co~~ outcomes, viz. H, T are equally likely if coin is unbaised.

(7) Independent Events:

Events are said to be independent of each other if happening of any one of them is not affected by and does not affect the happening of any one of others.

Ex: In tossing of die repeatedly, the event of getting '5' in 1st throw is independent of getting '5' in second, third or subsequent throws.

If a random experiment results in N exhaustive, mutualy exclusive and equally likely outcomes out of which m are favourable to the happening of an event A, then probability of occurence of A, usually denoted by P(A) is:

$$P(A) = \frac{\text{Favourable number of cases to A}}{\text{Exhaustive number of cases}} = \frac{m}{N}.$$

The probability of happening of the event A, i.e $P(A)$ is also known as the probability of success and is usually written as p and the probability of the non-happening of A, i.e $P(\bar{A})$ is known as the probability of failure, which is usually denoted by q.

Thus:

$$p+q=1 \Rightarrow q=1-p.$$

<u>Example</u>: In a single throw with two uniform dice find the probability of throwing "Five".

<u>Solution</u>: Exhaustive number of cases in a single throw with two dice is $6^2=36$.

Sum of '5' can be obtained on the two dice in the following mutually exclusive ways:

(1, 4), (4, 1), (2, 3), (3, 2)

$$\text{Probability} = \frac{4}{36} = \frac{1}{9} \text{ (Ans)}$$

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<u>Reference</u>: Fundamentals of Statistics by S.C. Gupta.