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CORE CONCEPT OF

BUSINESS MATHMATICS & STATISTICS

PROBABILITY

It is remarkable that a science, which began with the consideration of games of chance, should be elevated to the rank of the most important subject of human knowledge. —Pierre Simon Laplace

Introduction In everyday life, we come across statements such as
(1) It will probably rain today.
(2) I doubt that he will pass the test.
(3) Most probably, Kavita will stand first in the annual examination.
(4) Chances are high that the prices of diesel will go up.
(5) There is a 50-50 chance of India winning a toss in today's match.
The words 'probably', 'doubt', 'most probably', 'chances', etc., used in the statements above involve an element of uncertainty. For example,
(1), 'probably rain' will mean it may rain or may not rain today. We are predicting rain today based on our past experience when it rained under similar conditions. Similar predictions are also made in other cases listed in (2) to (5).
The uncertainty of 'probably' etc can be measured numerically by means of 'probability' in many cases. Though probability started with gambling, it has been used extensively in the fields of Physical Sciences, Commerce, Biological Sciences, Medical Sciences, Weather Forecasting, etc.

CONCEPT OF PROBABILITY

The dictionary meaning of the term probability is "likely though not certain to occur."
Probability of given event is an expression of likelihood or chance of occurrence of an event. A probability is a number which range from 0 to 1. 0 for an event cannot occur and 1for an event certain to occur.
Definition- "Probability is the limit of the relative frequency of successes in an infinite sequence of trials." – **Croxton and Cowden**

Classical Probability- This gives us the formula for classical probability. The probability of an event occurring is the number in the event divided by the number in the sample space. Again, this is only true when the events are equally likely. A classical probability is the relative frequency of each event in the sample space when each event is equally likely.

Probability of occurring an event (p) = No. of Favorable Events/ Total No. of Likely Event
For example, if there are 4 red and 5 white balls in a bag, the probability of the ball being red, in case of one ball is drawn, will be 4/9, because the number of favorable events is 4 and the total number of likely event is 9.

Empirical or Statistical Approach of Probability- It is also known as 'Relative Frequency Probability'. According to this approach probability is computed on the basis of available data or frequencies or past experiences.

FUNDAMENTAL CONCEPTS OR TERM RELATING TO PROBABILITY

Probability Experiment- Process which leads to well-defined results call outcomes
Outcome- The result of a single trial of a probability experiment
Sample Space- Set of all possible outcomes of a probability experiment
Event- One or more outcomes of a probability experiment
Classical Probability- Uses the sample space to determine the numerical probability that an event will happen. Also called theoretical probability.
Equally Likely Events- Events which have the same probability of occurring.
Complement of an Event- All the events in the sample space except the given events.
Empirical Probability- Uses a frequency distribution to determine the numerical probability. An empirical probability is a relative frequency.
Subjective Probability- Uses probability values based on an educated guess or estimate. It employs opinions and inexact information.
Mutually Exclusive Events- Two events which cannot happen at the same time.
Disjoint Events- Another name for mutually exclusive events.
Independent Events- Two events are independent if the occurrence of one does not affect the probability of the other occurring.
Dependent Events-Two events are dependent if the first event affects the outcome or occurrence of the second event in a way the probability is changed.

PROBABILITY THEOREMS

1) **Addition Theorem-** If two events (A & B) are mutually exclusive and probability of occurrence of A is P (A) and that B is P (B), then probability of occurrence of any event (A & B) will be the sum of the individual probabilities of A & B. If two events are mutually exclusive, then the probability of either occurring is the sum of the probabilities of each occurring.
   Symbolically Addition Rule

$$P(A \text{ or } B) = P(A) + P(B)$$

Non-Mutually Exclusive Events

In events which aren't mutually exclusive, there is some overlap. When P(A) and P(B) are added, the probability of the intersection (and) is added twice. To compensate for that double addition, the intersection needs to be subtracted.

General Addition Rule

P (A or B) = P (A) + P (B) - P (A and B)