**Introduction PROBABILITY THEORY**-

Probability theory is a branch of mathematics that deals with the study of uncertainty, randomness, and the likelihood of events occurring. It provides a mathematical framework to quantify and analyze the chances of different outcomes in various situations. Probability theory is widely applied in diverse fields, including statistics, economics, finance, physics, computer science, and engineering.

Here are some key aspects and concepts of probability theory:

1. Probability: Probability is a numerical measure that quantifies the likelihood of an event occurring. It is expressed as a value between 0 and 1, where 0 represents impossibility (an event that will never happen) and 1 represents certainty (an event that will always happen). The probability of an event A is denoted as P(A).
2. Sample Space: In probability theory, the sample space (denoted as Ω) is the set of all possible outcomes of an uncertain or random experiment. For example, when tossing a fair coin, the sample space is {Heads, Tails}.
3. Event: An event is a subset of the sample space, representing a specific outcome or a collection of outcomes of interest. Events can be simple (consisting of a single outcome) or compound (consisting of multiple outcomes). For example, in a dice roll, the event "rolling an even number" is a compound event.
4. Probability Distribution: A probability distribution describes the probabilities of all possible outcomes in a sample space. It assigns a probability to each event in the sample space. Common probability distributions include the uniform distribution, binomial distribution, normal distribution, and Poisson distribution.
5. Probability Axioms: Probability theory is built on a set of fundamental axioms, known as Kolmogorov's axioms, which provide the foundation for defining and manipulating probabilities. These axioms include the non-negativity axiom, the unit measure axiom, and the additivity axiom.
6. Conditional Probability: Conditional probability measures the likelihood of an event A occurring given that another event B has already occurred. It is denoted as P(A|B) and is calculated as the probability of the joint occurrence of events A and B divided by the probability of event B.
7. Independence: Two events A and B are considered independent if the occurrence (or non-occurrence) of one does not affect the probability of the other. Mathematically, events A and B are independent if and only if P(A ∩ B) = P(A) \* P(B).
8. Expected Value: The expected value, or mean, of a random variable is a measure of the central tendency of its probability distribution. It represents the average value that can be expected over a large number of repetitions of an experiment.
9. Law of Large Numbers: The law of large numbers states that as the number of trials or repetitions of a random experiment increases, the observed frequencies of events approach their true probabilities. In other words, the long-term relative frequency of an event converges to its theoretical probability.

Probability theory provides a rigorous framework for reasoning about uncertainty and randomness. It enables the quantification, modeling, and prediction of uncertain events, making it an essential tool in decision-making, risk assessment, and statistical analysis.