1. **Define the Bayesian interpretation of probability.**

Ans- The Bayesian interpretation of probability is a mathematical framework that assigns probabilities to uncertain events based on an individual's subjective degree of belief or prior knowledge about the events. In other words, the probability of an event is not an objective property of the event itself, but rather reflects the individual's subjective assessment of the likelihood of the event occurring.

1. **Define probability of a union of two events with equation.**

Ans- The probability of the union of two events A and B, denoted as P(A ∪ B), is the probability that either event A or event B (or both) will occur. It can be calculated using the following formula:

P(A ∪ B) = P(A) + P(B) - P(A ∩ B)

where P(A) is the probability of event A, P(B) is the probability of event B, and P(A ∩ B) is the probability of the intersection of events A and B, which is the probability that both events A and B occur simultaneously.

1. **What is joint probability? What is its formula?**

Ans- Joint probability is a probability that two or more events occur together. It is the probability of the intersection of two or more events. In other words, it is the probability that both Event A and Event B occur simultaneously.

The formula for joint probability is:

P(A ∩ B) = P(A) x P(B|A)

where P(A) is the probability of event A, P(B|A) is the conditional probability of event B given that event A has occurred.

1. **What is chain rule of probability?**

Ans- The chain rule of probability is a method for computing the probability of the intersection of multiple events. It is used when the events are not independent of each other, meaning that the probability of one event depends on the occurrence or non-occurrence of one or more other events.

The chain rule of probability states that the joint probability of n events A1, A2, ..., An can be expressed as the product of the conditional probabilities of each event given all the previous events:

P(A1 ∩ A2 ∩ ... ∩ An) = P(A1) x P(A2|A1) x P(A3|A1 ∩ A2) x ... x P(An|A1 ∩ A2 ∩ ... ∩ An-1)

where P(Ai|A1 ∩ A2 ∩ ... ∩ Ai-1) is the conditional probability of event Ai given that events A1, A2, ..., Ai-1 have occurred.

1. **What is conditional probability means? What is the formula of it?**

Ans- Conditional probability is the probability of an event A given that another event B has occurred. In other words, it is the probability of A, given that we know B has already occurred.

The formula for conditional probability is:

P(A|B) = P(A ∩ B) / P(B)

where P(A ∩ B) is the probability of the intersection of A and B, and P(B) is the probability of event B occurring.

1. **What are continuous random variables?**

Ans- Continuous random variables are variables that can take on any value within a certain range of values, typically over an infinite interval. They are characterized by a probability density function (PDF) that describes the probability of the variable taking on a specific value or range of values. Examples of continuous random variables include the height and weight of people, temperature, time, and rainfall. They are often used to model real-world phenomena and are in contrast to discrete random variables, which can only take on specific values.

1. **What are Bernoulli distributions? What is the formula of it?**

Ans- A Bernoulli distribution is a discrete probability distribution that describes the probability of a binary event, such as a coin flip, resulting in either success or failure. It has a probability mass function (PMF) that gives the probability of a success (1) or failure (0) in a single trial, given a probability of success parameter p. The Bernoulli distribution is characterized by its mean (μ = p) and variance (σ^2 = p(1-p)). It is commonly used in fields such as engineering, economics, and computer science to model binary events.

1. **What is binomial distribution? What is the formula?**

Ans- The binomial distribution is a discrete probability distribution that models the probability of having exactly k successes in n independent Bernoulli trials, where each trial has a fixed probability of success, denoted as p. The binomial distribution has a probability mass function that gives the probability of having k successes in n trials, and it is calculated using the formula:

P(X=k) = (n choose k) \* p^k \* (1-p)^(n-k)

where X is a random variable that represents the number of successes, k is a non-negative integer between 0 and n, inclusive, representing the number of successes, n is a positive integer representing the total number of trials, p is the probability of success on each trial, and (n choose k) is the binomial coefficient. The mean of the binomial distribution is μ = np, and the variance is σ^2 = np(1-p). The binomial distribution is widely used in statistics, finance, and other fields to model the probability of a certain number of successes or failures in a given number of trials.

1. **What is Poisson distribution? What is the formula?**

Ans- The Poisson distribution is a statistical probability distribution that is used to model the number of times an event occurs within a specific interval of time or space, given the average rate of occurrence.

The Poisson distribution formula is:

P(X=k) = (e^(-λ) \* λ^k) / k!

Where,

P(X=k) is the probability of k events occurring

λ is the mean rate of occurrence over the given interval

e is Euler's number, approximately equal to 2.71828

k is the number of events that occurred

k! represents the factorial of k, which is the product of all positive integers up to k.

The Poisson distribution is commonly used in fields such as biology, economics, and physics to model the occurrence of rare events, such as mutations, accidents, or arrivals at a facility, where the average rate of occurrence is known.

1. **Define covariance.**

Ans- Covariance is a statistical measure that quantifies the degree to which two variables are related to each other, indicating the joint variability of the two variables. A positive covariance indicates that the two variables tend to increase or decrease together, while a negative covariance indicates that one variable tends to increase when the other decreases. It is commonly used to measure the association between two random variables in various fields, including finance, engineering, and physics.

1. **Define correlation**

Ans- Correlation is a statistical measure that quantifies the strength and direction of the linear relationship between two variables. It is a standardized version of covariance, which takes into account the scales of the variables being measured, making it easier to interpret. A correlation coefficient ranges between -1 and +1, where a value of +1 indicates a perfect positive linear relationship, a value of -1 indicates a perfect negative linear relationship, and a value of 0 indicates no linear relationship. Correlation is commonly used in various fields, including finance, economics, psychology, and social sciences to identify and quantify relationships between variables.

1. **Define sampling with replacement. Give example.**

Ans- Sampling with replacement is a statistical method of selecting a sample of observations from a population, in which each observation is selected randomly and independently, and then returned to the population before the next observation is selected. This means that each observation has an equal chance of being selected on each draw, and the probability of selection remains the same for each observation throughout the sampling process.

For example, imagine you have a bag containing 10 marbles, numbered 1 to 10. If you were to randomly select one marble, record its number, and then return it to the bag before selecting another marble, this would be an example of sampling with replacement. This means that each time you draw a marble, all 10 marbles have an equal probability of being selected, regardless of what was drawn before.

1. **What is sampling without replacement? Give example.**

Ans- Sampling without replacement is a statistical method of selecting a sample of observations from a population, in which each observation is selected randomly and independently, but is not returned to the population before the next observation is selected. This means that each observation can only be selected once, and the probability of selection changes for each observation throughout the sampling process.

For example, imagine you have a bag containing 10 marbles, numbered 1 to 10. If you were to randomly select one marble, record its number, and then not return it to the bag before selecting another marble, this would be an example of sampling without replacement. This means that each time you draw a marble, the probability of selecting each remaining marble changes, depending on what has been drawn before.

1. **What is hypothesis? Give example.**

Ans- In statistics, a hypothesis is a statement or assumption about a population parameter, which can be tested using statistical methods to determine its validity. Hypotheses are often used in research and experimentation to make predictions about the outcome of a study or to determine the relationship between variables.

For example, suppose we want to test the hypothesis that the average height of male college students in a certain population is 6 feet. This hypothesis can be stated formally as:

H0: μ = 6, where μ is the population mean height of male college students.

To test this hypothesis, we can collect a random sample of male college students and measure their heights. We can then use statistical methods to calculate the sample mean and compare it to the hypothesized population mean of 6 feet. If the sample mean is significantly different from 6 feet, we can reject the null hypothesis (H0) and conclude that the true population mean is not 6 feet.

Hypothesis testing is an important tool in statistical inference, allowing us to make conclusions about populations based on sample data, while accounting for uncertainty and variability in the data.