1. Define the Bayesian interpretation of probability.

A1. The Bayesian interpretation of probability views probability as a measure of the degree of belief or confidence in an event, given available evidence or prior knowledge. In this view, probability is subjective and updated based on new evidence or information. Bayes' theorem is a fundamental principle of Bayesian probability, which provides a framework for updating beliefs based on new information.

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

A2. The probability of a union of two events A and B is defined as:

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

Where P(A) represents the probability of event A, P(B) represents the probability of event B, and P(A and B) represents the probability of the intersection of A and B. The formula essentially subtracts the probability of the intersection of A and B to avoid double-counting the probability of the overlapping region.

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

A3.   
Joint probability is the probability of two or more events occurring simultaneously. The formula for joint probability of two events A and B is:

P(A and B) = P(A) \* P(B | A)

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

1. What is chain rule of probability?

A4.   
The chain rule of probability is a formula used to compute the probability of multiple events occurring together by breaking it down into conditional probabilities. It states that the joint probability of n events can be calculated as the product of the conditional probability of each event given the occurrence of all the previous events in the chain. Mathematically, it can be written as:

P(A1, A2, A3, ..., An) = P(A1) \* P(A2 | A1) \* P(A3 | A1, A2) \* ... \* P(An | A1, A2, ..., An-1)

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

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

A5. Conditional probability is the likelihood of an event happening, given that another event has already occurred. It is denoted by P(A|B), which is read as the probability of event A occurring, given that event B has 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 events A and B occurring, and P(B) is the probability of event B occurring.

1. What are continuous random variables?

A6. Continuous random variables are random variables that can take on any value in a continuous range of values. These variables can take on an infinite number of possible values, often represented by an interval on the real number line. Examples of continuous random variables include height, weight, and time. The probability density function (PDF) is used to describe the probability distribution of a continuous random variable, and the area under the PDF curve between any two points gives the probability that the variable will fall between those two values.

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

A7. Bernoulli distribution is a discrete probability distribution that models the probability of a binary outcome, such as success or failure, where success has a probability of p and failure has a probability of (1-p). The formula for Bernoulli distribution is:

P(X=x) = p^x \* (1-p)^(1-x)

where X is the random variable that takes the value 1 for success and 0 for failure, and p is the probability of success.

For example, the probability of flipping a coin and getting heads (success) can be modeled using a Bernoulli distribution with p=0.5, where X=1 represents heads and X=0 represents tails.

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

A8. Binomial distribution is a probability distribution that describes the number of successes in a fixed number of independent trials, where each trial can have only two outcomes - success or failure. The formula for the binomial distribution is:

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

where:

* P(X=k) is the probability of getting k successes
* n is the total number of trials
* k is the number of successes
* p is the probability of success in a single trial
* (1-p) is the probability of failure in a single trial
* C(n, k) is the binomial coefficient, also known as the "n choose k" formula, which represents the number of ways to choose k items from a set of n items.

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

A9. Poisson distribution is a discrete probability distribution that expresses the probability of a given number of events occurring in a fixed interval of time or space, given that these events occur with a known average rate and independently of the time since the last event. The formula for the Poisson distribution is:

P(X = k) = (e^(-λ) \* λ^k) / k!

where:

* P(X = k) is the probability of k events occurring in the given time or space interval
* e is the mathematical constant approximately equal to 2.71828
* λ is the average rate of events in the given time or space interval
* k is the number of events occurring in the given time or space interval
* k! is the factorial of k, i.e., the product of all positive integers up to k

1. Define covariance.

A10. Covariance is a measure that describes the joint variability of two random variables. In other words, it measures the degree to which two variables are linearly related. A positive covariance means that the two variables tend to vary in the same direction, while a negative covariance means that they tend to vary in opposite directions. The formula for the covariance between two random variables X and Y is given by:

Cov(X, Y) = E[(X - E[X])(Y - E[Y])]

where E[X] and E[Y] are the expected values of X and Y, respectively.

1. Define correlation

A11. Correlation refers to the statistical relationship between two or more variables. It is a measure of the strength and direction of the linear relationship between variables. A correlation coefficient is used to quantify the correlation between two variables, with values ranging from -1 to +1. A coefficient of -1 indicates a perfect negative correlation, +1 indicates a perfect positive correlation, and 0 indicates no correlation at all.

1. Define sampling with replacement. Give example.

A12.   
Sampling with replacement is a statistical sampling technique in which a sample is selected randomly from a population, and each selected unit is replaced before the next unit is selected. This means that each unit in the population has an equal probability of being selected more than once, or not at all, in the sample.

For example, consider a bag with 5 balls, numbered 1 to 5. If we randomly select a ball from the bag, note the number, and put the ball back in the bag before the next selection, we are sampling with replacement. This means that each ball has an equal chance of being selected in each draw, regardless of whether it was selected in previous draws or not. So, it is possible to select the same ball multiple times.

1. What is sampling without replacement? Give example.

A13. Sampling without replacement is a method of sampling elements from a population where each element can be selected only once, and once selected, it is removed from the population. For example, if we have a deck of cards and we draw one card at a time without replacing it, the probability of drawing each card in the deck changes with each draw.

For instance, let's say we have a bag of 10 marbles, numbered 1 to 10. If we select a marble without replacing it, the probability of selecting any marble on the next draw would be different from the previous one since there is one less marble in the bag. If we first select marble #1, the probability of selecting marble #2 will be 1/9 instead of 1/10.

1. What is hypothesis? Give example.

A14. In statistics, a hypothesis is a statement that is assumed to be true about a population parameter. It is often used to test a claim or a belief about a particular population.

For example, let's say we want to know if the average height of men in a certain city is greater than 6 feet. We can form a hypothesis stating that the average height of men in that city is indeed greater than 6 feet. We can then collect a sample of men from that city and test our hypothesis by analyzing their heights. Based on the results of our analysis, we can either accept or reject our hypothesis.