Here are detailed explanations of each of the points:

**1. Bayesian Interpretation of Probability:**

The **Bayesian interpretation of probability** is a way of thinking about probability as a measure of belief or certainty about an event, given prior knowledge or evidence. In this interpretation, probability is subjective and updated as new data or information becomes available.

**Formula**:

P(A∣B)=P(B∣A)P(A)P(B)P(A|B) = \frac{P(B|A)P(A)}{P(B)}

Where:

* P(A∣B)P(A|B) is the probability of AA given BB (posterior probability),
* P(B∣A)P(B|A) is the probability of BB given AA (likelihood),
* P(A)P(A) is the initial belief about AA (prior probability),
* P(B)P(B) is the probability of BB (normalizing constant).

**2. Probability of a Union of Two Events:**

The probability of the union of two events AA and BB is the probability that either event AA or event BB (or both) occur.

**Formula**:

P(A∪B)=P(A)+P(B)−P(A∩B)P(A \cup B) = P(A) + P(B) - P(A \cap B)

Where:

* P(A∪B)P(A \cup B) is the probability that AA or BB or both occur,
* P(A)P(A) and P(B)P(B) are the individual probabilities of AA and BB,
* P(A∩B)P(A \cap B) is the probability of both AA and BB occurring together.

**3. Joint Probability:**

**Joint probability** is the probability of two events AA and BB occurring together. It is the likelihood of both events happening at the same time.

**Formula**:

P(A∩B)=P(A∣B)P(B)=P(B∣A)P(A)P(A \cap B) = P(A|B)P(B) = P(B|A)P(A)

Where:

* P(A∩B)P(A \cap B) is the joint probability of events AA and BB,
* P(A∣B)P(A|B) is the probability of AA occurring given that BB occurs, and vice versa.

**4. Chain Rule of Probability:**

The **chain rule of probability** allows us to decompose the probability of a sequence of events into a product of conditional probabilities. It is useful when dealing with multiple random variables.

**Formula**:

P(A1,A2,…,An)=P(A1)⋅P(A2∣A1)⋅⋯⋅P(An∣A1,A2,…,An−1)P(A\_1, A\_2, \dots, A\_n) = P(A\_1) \cdot P(A\_2|A\_1) \cdot \dots \cdot P(A\_n|A\_1, A\_2, \dots, A\_{n-1})

**5. Conditional Probability:**

**Conditional probability** is the probability of an event occurring given that another event has already occurred. It is used to update the probability of an event based on additional information.

**Formula**:

P(A∣B)=P(A∩B)P(B)P(A|B) = \frac{P(A \cap B)}{P(B)}

Where:

* P(A∣B)P(A|B) is the probability of AA given BB,
* P(A∩B)P(A \cap B) is the joint probability of AA and BB,
* P(B)P(B) is the probability of event BB.

**6. Continuous Random Variables:**

**Continuous random variables** are variables that can take any value within a given range. These values are not countable but instead exist on a continuum, often representing measurements.

**Examples**:

* Height of individuals,
* Temperature in a region,
* Time taken to complete a task.

**7. Bernoulli Distributions:**

The **Bernoulli distribution** models binary outcomes, where there are two possible outcomes: success or failure (usually denoted as 1 and 0, respectively).

**Formula**:

P(X=x)=px(1−p)1−x,x∈{0,1}P(X = x) = p^x(1-p)^{1-x}, \quad x \in \{0, 1\}

Where:

* pp is the probability of success,
* xx is the outcome (0 for failure, 1 for success).

**8. Binomial Distribution:**

The **binomial distribution** models the number of successes in a fixed number of independent Bernoulli trials. Each trial has two possible outcomes (success or failure), and the probability of success remains constant across trials.

**Formula**:

P(X=k)=(nk)pk(1−p)n−kP(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}

Where:

* nn is the number of trials,
* kk is the number of successes,
* pp is the probability of success in a single trial.

**9. Poisson Distribution:**

The **Poisson distribution** models the number of events occurring in a fixed interval of time or space, where events occur independently and at a constant rate.

**Formula**:

P(X=k)=λke−λk!P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}

Where:

* λ\lambda is the average rate of occurrence,
* kk is the number of events,
* ee is the base of the natural logarithm.

**10. Covariance:**

**Covariance** measures the relationship between two random variables. It indicates whether an increase in one variable would result in an increase or decrease in another.

**Formula**:

Cov(X,Y)=1n∑i=1n(Xi−μX)(Yi−μY)\text{Cov}(X, Y) = \frac{1}{n} \sum\_{i=1}^{n} (X\_i - \mu\_X)(Y\_i - \mu\_Y)

Where:

* XX and YY are the two variables,
* μX\mu\_X and μY\mu\_Y are the means of XX and YY,
* nn is the number of data points.

**11. Correlation:**

**Correlation** is a measure of the strength and direction of the linear relationship between two variables. It is the normalized version of covariance.

**Formula**:

ρ(X,Y)=Cov(X,Y)σXσY\rho(X, Y) = \frac{\text{Cov}(X, Y)}{\sigma\_X \sigma\_Y}

Where:

* Cov(X,Y)\text{Cov}(X, Y) is the covariance,
* σX\sigma\_X and σY\sigma\_Y are the standard deviations of XX and YY.

**12. Sampling with Replacement:**

**Sampling with replacement** means that after each selection, the item is returned to the population, so it could be selected again in future draws.

**Example**: If you draw a card from a deck, note its value, and then return the card to the deck before drawing again, this is sampling with replacement.

**13. Sampling without Replacement:**

**Sampling without replacement** means that once an item is selected, it is removed from the population, and it cannot be selected again.

**Example**: Drawing balls from a box without putting them back after each draw is sampling without replacement.

**14. Hypothesis:**

A **hypothesis** is a proposed explanation or prediction about a phenomenon that can be tested through experimentation or observation.

**Example**: "If I increase the amount of water given to plants, then the plants will grow taller."