**[Que-28] - What is Normal Distribution? What are the four Assumptions of Normal Distribution? Explain in detail.**

**Normal Distribution:**

Normal distribution, also known as Gaussian distribution, is a continuous probability distribution that is characterized by its bell-shaped curve. It is widely used in statistics because of its simplicity and applicability in a wide variety of natural and social phenomena. In a normal distribution:

* The mean, median, and mode are all equal.
* It is symmetric around the mean.
* The total area under the curve is equal to 1.

The shape of the normal distribution is determined by two parameters:

* **Mean (μ)**: The central tendency of the distribution, around which the data points are centered.
* **Standard deviation (σ)**: A measure of the spread or dispersion of the data points around the mean. It determines the width of the distribution.

**Four Assumptions of Normal Distribution:**

1. **Symmetry (Bell-shaped Curve):**
   * The normal distribution is symmetric around its mean. This means that the values to the left and right of the mean are approximately mirror images of each other.
2. **Unimodal (Single Peak):**
   * There is only one peak in the distribution, corresponding to the mean. This implies that there is one most likely value for the data.
3. **Fixed Mean and Standard Deviation:**
   * The distribution is fully characterized by its mean (μ) and standard deviation (σ). Once these parameters are known, the shape of the distribution is completely determined.
4. **Normality of Observations:**
   * Each individual observation in the dataset follows a normal distribution. This assumption is crucial for using statistical methods that rely on the normal distribution, such as calculating probabilities, confidence intervals, and hypothesis testing.

**Explanation:**

1. **Symmetry (Bell-shaped Curve):**
   * The normal distribution is symmetric around its mean. This means that if you were to draw a vertical line through the center of the distribution, the area under the curve to the left of this line would be approximately equal to the area to the right of the line. Visually, this results in the characteristic bell-shaped curve, where the peak of the curve represents the mean.
2. **Unimodal (Single Peak):**
   * Normal distributions have only one peak, which corresponds to the mean of the distribution. This single peak indicates that there is a central tendency around which the data points cluster. While there might be variations in the data, the majority of values tend to cluster around the mean, tapering off symmetrically as you move away from it.
3. **Fixed Mean and Standard Deviation:**
   * The mean (μ) and standard deviation (σ) of a normal distribution are fixed parameters that describe its central tendency and spread, respectively. The mean determines the location of the peak (center) of the distribution, while the standard deviation determines how spread out the data points are around the mean. A larger standard deviation means that the data points are more spread out, resulting in a wider bell-shaped curve.
4. **Normality of Observations:**
   * For a dataset to be considered normally distributed, each individual observation within that dataset should follow a normal distribution. This means that if you were to plot a histogram of the data, it should approximate a bell-shaped curve. Normality of observations is typically assessed through statistical tests and visual inspections of data distributions.