Q1. What is a probability distribution, exactly? If the values are meant to be random, how can you predict them at all?

Ans1- A probability distribution is a mathematical function or model that describes the likelihood of various outcomes in a random experiment or process. It provides a way to assign probabilities to different values or events. While the individual values in a probability distribution may be random, the distribution itself is not. It represents the probabilities associated with each possible outcome, allowing us to make predictions about the likelihood of specific events occurring. In essence, probability distributions help us understand and quantify uncertainty in various phenomena, such as the outcomes of coin tosses, dice rolls, or the spread of data in statistical analysis.

Q2. Is there a distinction between true random numbers and pseudo-random numbers, if there is one? Why are the latter considered “good enough”?

Ans2- Yes, there is a distinction between true random numbers and pseudo-random numbers. True random numbers are generated from inherently unpredictable physical processes, like radioactive decay or atmospheric noise. Pseudo-random numbers, on the other hand, are generated using deterministic algorithms and initial seed values. They appear random, but they are not truly random because, given the same seed value, the sequence of pseudo-random numbers will be identical. Pseudo-random numbers are considered "good enough" for most applications because they exhibit statistical properties similar to true randomness and are efficient to generate, making them suitable for tasks like simulations, cryptography, and random sampling.

Q3. What are the two main factors that influence the behaviour of a "normal" probability distribution?

Ans3- The two main factors that influence the behavior of a "normal" probability distribution are the mean (average) and the standard deviation. The mean represents the central value or the peak of the distribution, while the standard deviation measures the spread or variability of the data. In a normal distribution, about 68% of the data falls within one standard deviation of the mean, about 95% within two standard deviations, and about 99.7% within three standard deviations. These parameters determine the shape and characteristics of the bell-shaped curve associated with a normal distribution.

Q4. Provide a real-life example of a normal distribution.

Ans4- A real-life example of a normal distribution is the distribution of human heights in a large population. In this case, the mean height represents the average height of the population, and the standard deviation indicates how much individual heights vary from the mean. The majority of people will have heights close to the mean, with fewer individuals being significantly taller or shorter. This distribution forms a bell-shaped curve, with most individuals clustered around the average height, and fewer individuals as you move further away from the mean.

Q5. In the short term, how can you expect a probability distribution to behave? What do you think will happen as the number of trials grows?

Ans5- In the short term, a probability distribution may exhibit variability, and individual outcomes may not conform to the expected probabilities. However, as the number of trials or observations increases, the distribution tends to converge toward its theoretical probabilities. This phenomenon is known as the Law of Large Numbers. In the long run, the observed outcomes will more closely match the predicted probabilities, and the distribution will behave more predictably.

Q6. What kind of object can be shuffled by using random.shuffle?

Ans6- The random.shuffle function in Python can be used to shuffle (randomly rearrange) the elements of a mutable sequence, such as a list. It randomly reorders the elements within the sequence, providing a simple way to achieve randomness in the arrangement of items in a list or similar data structure.

Q7. Describe the math package's general categories of functions.

Ans7- Python's math package includes several general categories of functions:

Mathematical Constants: Constants like pi (π) and Euler's number (e).

Arithmetic Functions: Basic mathematical operations like addition, subtraction, multiplication, and division.

Exponential and Logarithmic Functions: Functions for exponentiation and logarithms.

Trigonometric Functions: Sine, cosine, tangent, and their inverses.

Q8. What is the relationship between exponentiation and logarithms?

Ans8- Exponentiation and logarithms are inverse mathematical operations. Exponentiation involves raising a base number to a certain power, while logarithms find the exponent to which a base number must be raised to obtain a given value

Q9. What are the three logarithmic functions that Python supports?

Ans9- Python supports three logarithmic functions:

math.log(x, base): Computes the logarithm of x with the specified base.

math.log10(x): Calculates the base-10 logarithm of x (common logarithm).

math.log2(x): Computes the base-2 logarithm of x (binary logarithm).