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

Ans- A probability distribution is a mathematical function that describes the likelihood of a random variable taking on a certain value or set of values. It tells you how frequently different outcomes are expected to occur, given the probability of each possible outcome.

The values themselves are not necessarily predictable, but the probabilities associated with each possible value . For example, if you roll a fair six-sided die, the probability of rolling a 2 is 1/6, the probability of rolling a 3 is 1/6, and so on. While you cannot predict exactly what value you will get when you roll the die, you can predict the probability of each possible outcome based on the rules of probability.

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

Ans- Yes, there is a distinction between true random numbers and pseudo-random numbers. True random numbers are generated by physical processes that are inherently unpredictable, such as atmospheric noise, radioactive decay, or thermal noise in electronic circuits. Because these processes are truly random, the resulting numbers are also random and unpredictable.

Pseudo-random numbers, on the other hand, are generated using algorithms that are designed to produce sequences of numbers that appear to be random, even though they are not truly random. These algorithms use a seed value as input, and produce a sequence of numbers based on that seed. While the sequences they produce are not truly random, they can be made to have many of the same statistical properties as truly random sequences.

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

Ans- The two main factors that influence the behaviour of a "normal" probability distribution are its mean (μ) and standard deviation (σ).

The mean represents the central tendency or average of the distribution. It is the point around which the distribution is symmetrically cantered. If the mean is shifted to the left or right, the entire distribution will shift with it.

The standard deviation is a measure of the spread or variability of the distribution. It tells us how much the data is scattered around the mean.

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

Ans- A real-life example of a normal distribution is the distribution of heights in a population.If we were to measure the height of every individual in a large population and create a histogram of the results, we would likely observe a bell-shaped curve that approximates a normal distribution. The mean height would be the central tendency of the distribution, and the standard deviation would tell us how much the height of individuals in the population varies from the mean.

For example, let's say we measured the heights of 10,000 people and found that the mean height was 5 feet 6 inches, with a standard deviation of 3 inches. This means that the majority of individuals in the population would have heights close to the mean, with fewer individuals at the extreme ends of the distribution.

**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?**

Ans-In the short term, a probability distribution may not behave as expected due to random variation. For example, if you flip a fair coin 10 times, you might not get exactly 5 heads and 5 tails, even though that is the expected outcome over the long run. This is because there is a certain amount of randomness involved in each individual trial.

However, as the number of trials grows, the probability distribution is expected to behave more and more like its theoretical prediction. This is because the law of large numbers states that as the number of trials (or samples) increases, the average of the outcomes will approach the expected value of the distribution.

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

Ans- The random.shuffle function is typically used to shuffle a sequence in-place. A sequence is an ordered collection of objects that can be indexed, such as a list or a tuple.

Thus, any sequence that contains mutable objects, such as lists or arrays, can be shuffled using the random.shuffle function. For example, you can shuffle a list of integers, a list of strings, or a list of objects of any other data type.

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

Ans- The Python math module provides a wide range of mathematical functions for numerical calculations, which can be broadly categorized into the following categories:

1. Trigonometric functions, such as sin(), cos(), and tan(), which deal with the relationships between angles and sides of a triangle.
2. Exponential and logarithmic functions, such as exp(), log(), and log10(), which deal with exponential growth and decay, and logarithmic scales.
3. Numeric functions, such as abs(), floor(), ceil(), and round(), which deal with numerical calculations and manipulations.
4. Constants, such as pi and e, which provide useful mathematical constants.
5. Other functions, such as sqrt(), pow(), and gcd(), which provide a variety of additional mathematical operations.

**Q8. What is the relationship between exponentiation and logarithms?**

Ans- Exponentiation and logarithms are inverse operations of each other. The logarithm of a number is the exponent to which another fixed number, called the base, must be raised to produce that number. In other words, the logarithm is the inverse of exponentiation. For example, if 2^3 = 8, then log base 2 of 8 = 3.

Exponentiation and logarithms are used in many mathematical and scientific contexts, such as calculating compound interest, measuring the loudness of sound, and analysing growth rates in biology and economics.

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

Ans- Python supports three logarithmic functions in its built-in math module:

1. math.log(x[, base]): This function returns the natural logarithm (base e) of x. If the optional base argument is specified, it returns the logarithm of x with respect to that base.

Example: math.log(10) returns 2.302585092994046.

1. math.log10(x): This function returns the base-10 logarithm of x.

Example: math.log10(100) returns 2.0.

1. math.log2(x): This function returns the base-2 logarithm of x.

Example: math.log2(8) returns 3.0.