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

A probability distribution is a mathematical function or model that describes the likelihood of different outcomes or events occurring in a random process. It provides a way to quantify the probabilities associated with each possible outcome.

While the individual values generated from a probability distribution are random, the distribution itself follows a specific pattern or set of rules that govern the probabilities of different outcomes. The distribution characterizes the likelihood of each possible value occurring within a given range or set of values.

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

Yes, there is a distinction between true random numbers and pseudo-random numbers.

True random numbers are generated from physical processes that are inherently unpredictable, such as atmospheric noise, radioactive decay, or thermal noise. These processes produce random and unbiased outcomes that cannot be easily replicated or predicted. True random numbers are considered to be truly random and have properties like uniformity and independence.

On the other hand, pseudo-random numbers are generated by deterministic algorithms. These algorithms use a seed value as an initial input and produce a sequence of numbers that appear random but are actually generated through a deterministic process. Given the same seed value, a pseudo-random number generator (PRNG) will always produce the same sequence of numbers.

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

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

* Mean (μ): The mean represents the central tendency or average value of the distribution. It determines the location of the peak or center of the distribution. Shifting the mean to the left or right changes the position of the peak without affecting the shape of the distribution.
* Standard Deviation (σ): The standard deviation measures the spread or variability of the distribution. It determines the width of the distribution. A smaller standard deviation indicates a narrower and more concentrated distribution, while a larger standard deviation results in a wider and more dispersed distribution.

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

One real-life example of a normal distribution is the distribution of heights of adult males in a population. In many populations, the heights of adult males tend to follow a normal distribution. The mean height represents the average height of adult males, and the standard deviation represents the variation in height among individuals.

In this distribution, most adult males will have heights close to the mean, with fewer individuals having heights farther away from the mean. The distribution forms a bell-shaped curve, where the majority of individuals cluster around the mean height, and the frequency of individuals decreases as you move away from the mean in either direction.

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?

In the short term, the behavior of a probability distribution can be unpredictable and may not conform to its expected long-term behavior. This is because in a small number of trials or observations, random variations can have a significant impact on the outcomes, leading to deviations from the expected probabilities

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

The random.shuffle function in Python can be used to shuffle the elements of a sequence object. A sequence object is any object that supports sequence operations like indexing and slicing. Examples of sequence objects include lists, tuples, and strings.

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

The math package in Python provides a wide range of mathematical functions. These functions can be categorized into several general categories:

Basic arithmetic functions: The math package includes functions for basic arithmetic operations such as addition, subtraction, multiplication, division, and exponentiation. Examples include math.add, math.subtract, math.multiply, math.divide, and math.pow.

Trigonometric functions: The math package provides functions for common trigonometric operations such as sine, cosine, tangent, arc sine, arc cosine, and arc tangent. Examples include math.sin, math.cos, math.tan, math.asin, math.acos, and math.atan.

Q8. What is the relationship between exponentiation and logarithms?

The relationship between exponentiation and logarithms is based on the inverse relationship between these two mathematical operations.

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

Python supports three logarithmic functions in the math module:

math.log(x, base): This function returns the natural logarithm (base e) of x. The base parameter is optional and if provided, it returns the logarithm of x to the specified base.

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

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

These logarithmic functions allow you to calculate logarithms of different bases, which are commonly used in various mathematical and scientific computations.