

Learning Module 6: Simulation Methods

Q.3512 Which of the following statements is *most accurate*? Lognormal Distributions are:

- A. skewed to the right.
- B. skewed to the left and often used to model asset prices.
- C. skewed to the left and rarely used to model asset prices.

The correct answer is **A**.

Lognormal distributions are skewed to the right. They are often used to model stock prices since the distribution is bounded by zero.

B is incorrect. Lognormal distributions are skewed to the right (positively skewed)

C is incorrect. Lognormal distributions are bound by zero. This implies that they are skewed to the right (positively skewed). For the same reason, lognormal distributions are the preferred distribution when modeling asset prices because asset prices cannot be negative.

CFA Level I, Volume 1, Topic 2 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7a: explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices when using continuously compounded asset returns

Q.4023 Which of the following is *least likely* a parameter of lognormal distribution;

- A. Mean.
- B. Median.
- C. Standard deviation.

The correct answer is **B**.

While the median is a measure of central tendency, it is not typically considered a parameter of the distribution. Parameters usually refer to the characteristics that define the shape and scale of the distribution, such as the mean and standard deviation of the logarithmic values in the case of a lognormal distribution.

A and C are incorrect: The mean and standard deviation are parameters of a lognormal distribution.

CFA Level I, Volume 1, Topic 2 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7a: explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices when using continuously compounded asset returns

Q.4592 The monthly closing prices of ApexTech Corporation shares are as follows:

Date	Closing Price (USD)
30 June	105
31 July	120
31 August	130

The continuous compounded return of ApexTech Corporation shares for the period from June 30 to August 31 is closest to:

- A. 10.58 percent.
- B. 10.68 percent.
- C. 21.36 percent.

The correct answer is C.

The continuously compounded return (CCR) can be calculated using the formula:

$$CCR = \ln\left(\frac{\text{Ending Price}}{\text{Beginning Price}}\right)$$

Therefore;

$$CCR = \ln\left(\frac{130}{105}\right) = \ln(1.2381) \approx 0.2136 \text{ or } 21.36\%$$

CFA Level I, Volume 1, Topic 2 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7a: explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices when using continuously compounded asset returns

Q.4593 In financial modeling, the lognormal distribution is often preferred over the normal distribution for representing asset prices primarily because asset prices are:

- A. Non-decreasing.
- B. Without upper limits.
- C. Positively constrained.

The correct answer is **C**.

The lognormal distribution is used to model asset prices because it ensures that prices cannot be negative, which is a fundamental characteristic of asset prices in the real world.

A is incorrect: Asset prices can decrease. They are not guaranteed to be non-decreasing.

B is incorrect: While it's true that asset prices are unbounded on the upper side, this is not the primary reason for choosing the lognormal distribution over the normal distribution. The key reason is the non-negativity constraint.

CFA Level I, Volume 1, Topic 2 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7a: explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices when using continuously compounded asset returns

Q.4594 Consider a random variable Y that is distributed according to a lognormal distribution. Which of the following statements is most accurate regarding the relationship between Y and its natural logarithm, $\ln(Y)$?

- A. If Y is lognormally distributed, then $\ln(Y)$ follows a uniform distribution.
- B. If $\ln(Y)$ is normally distributed, then Y cannot be lognormally distributed.
- C. If $\ln(Y)$ is normally distributed, then Y is lognormally distributed.

The correct answer is **C**.

The definition of a lognormal distribution is that a variable Y is lognormally distributed if its natural logarithm, $\ln(Y)$, is normally distributed. Therefore, if $\ln(Y)$ is normally distributed, it follows that Y must be lognormally distributed.

A is incorrect: The natural logarithm of a lognormally distributed variable follows a normal distribution, not a uniform distribution.

B is incorrect: It contradicts the definition of a lognormal distribution.

CFA Level I, Volume 1, Topic 2 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7a: explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices when using continuously compounded asset returns

Q.4596 Which of the following statements *best* explains why the lognormal distribution is commonly used to model asset prices in financial markets?

- A. The lognormal distribution is symmetric and can model asset prices that can take on negative values.
- B. The lognormal distribution has a lower bound at zero, making it suitable for modeling asset prices that cannot be negative.
- C. When the continuously compounded returns on a stock are normally distributed, the stock prices are also normally distributed.

The correct answer is **B**.

The lognormal distribution is appropriate for modeling asset prices because it has a lower bound at zero, ensuring that asset prices cannot be negative. This characteristic aligns with the real-world behavior of asset prices. Additionally, when continuously compounded returns are normally distributed, the stock prices follow a lognormal distribution, further supporting the use of the lognormal distribution for modeling asset prices.

A is incorrect: Lognormal distribution is not symmetric and it is specifically used because it cannot take on negative values.

C is incorrect: It contradicts the relationship between returns and prices. If continuously compounded returns are normally distributed, the stock prices follow a lognormal distribution, not a normal distribution.

CFA Level I, Volume 1, Topic 2 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7a: explain the relationship between normal and lognormal distributions and why the lognormal distribution is used to model asset prices when using continuously compounded asset returns

Q.4597 Which of the following is an *appropriate* application of Monte Carlo simulation in financial modeling?

- A. Providing exact valuations for call options without any further analysis.
- B. Evaluating the impact of varying assumptions on a model, such as the distribution of critical variables.
- C. Generating a series of returns based on historical data patterns.

The correct answer is **B**.

By generating a large number of random samples from specified probability distributions, Monte Carlo simulation can be used to investigate the sensitivity of a model's output to changes in assumptions. This is particularly useful for understanding how different scenarios or changes in the distribution of key variables can impact the results of the model.

A is incorrect: While Monte Carlo simulation is used for valuing call options, it does not provide "exact" valuations. Instead, it provides estimates based on simulating numerous scenarios. The accuracy of these valuations depends on the assumptions and parameters used in the simulation.

C is incorrect: Although Monte Carlo simulation can be used to simulate future asset price paths; this option does not capture the essence of what makes Monte Carlo simulation a valuable tool in financial modeling. The focus on "historical data patterns" is too narrow, as Monte Carlo simulation often involves simulating returns based on various stochastic models and assumptions, not just historical patterns.

CFA Level I, Volume 1, Topic 3 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7b: describe Monte Carlo simulation and explain how it can be used in investment applications.

Q.4598 XYZ Corporation is evaluating a new investment project using Monte Carlo simulation. The finance team has constructed a model to simulate the project's potential returns under various scenarios. However, they are concerned about the limitations of this approach. Which of the following is ***most likely*** a limitation of the Monte Carlo simulation used by XYZ Corporation?

- A. Only provides statistical estimates of results, not exact figures.
- B. Inability to conduct scenario analysis.
- C. Dependence on historical return data.

The correct answer is **A**.

One limitation of Monte Carlo simulation is that it provides estimates based on a range of possible outcomes rather than exact figures. This is due to the inherent nature of the simulation, which relies on random sampling and probabilistic models.

B is incorrect: Monte Carlo simulation is actually well-suited for "what if" or scenario analysis. It allows users to change assumptions and observe the outcomes under different scenarios, making it a valuable tool for exploring a range of possibilities.

C is incorrect: While historical data can be used in Monte Carlo simulation, it is not a requirement. Simulations can be based on a variety of assumptions and probability distributions, not just historical records.

CFA Level I, Volume 1, Topic 3 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7b: describe Monte Carlo simulation and explain how it can be used in investment applications.

Q.4599 Consider the following statements made by Tom, Anna, and Fiona regarding the concept of Monte Carlo simulation as used in financial modeling. **Tom:** A probabilistic approach that employs random sampling to generate a range of possible outcomes and assesses their likelihood in uncertain environments. **Anna:** A deterministic method that relies on fixed inputs to forecast future financial outcomes with certainty. **Fiona:** A statistical technique that uses random sampling and historical data to predict the behavior of financial markets. Based on the statements provided, who **best** describes the concept of Monte Carlo simulation as used in financial modeling?

- A. Tom
- B. Anna
- C. Fiona

The correct answer is **A**.

Tom accurately describes Monte Carlo simulation. He highlights the probabilistic nature of the technique, its use of random sampling to create multiple scenarios, and its application in assessing risks and uncertainties in financial models.

B is incorrect: Anna inaccurately describes Monte Carlo simulation is not a deterministic method. However, it is a probabilistic approach that accounts for uncertainty by generating multiple scenarios.

C is incorrect: Fiona inaccurately describes Monte Carlo simulation. While Monte Carlo simulation is a statistical technique that involves random sampling, it does not exclusively rely on historical data nor is it limited to predicting market behavior. It can be used in various financial modeling contexts.

CFA Level I, Volume 1, Topic 3 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7b: describe Monte Carlo simulation and explain how it can be used in investment applications.

Q.4600 Which of the following is ***least likely*** a use of Monte Carlo simulation in valuing a lookback contingent claim?

- A. Generating a large number of possible paths for the underlying asset price over the life of the option.
- B. Calculating the average of all the discounted payoffs from the simulated paths to estimate the fair value of the claim.
- C. Using historical asset price data to determine the exact payoff of the lookback option at expiration.

The correct answer is C.

This is NOT a use of Monte Carlo simulation in valuing a lookback contingent claim. Monte Carlo simulation involves simulating future asset price paths and does not rely on historical data to determine the exact payoff at expiration. The payoff is determined based on the simulated maximum or minimum asset prices, not historical data.

A is incorrect: This is a correct use of Monte Carlo simulation in valuing a lookback contingent claim. It allows for the simulation of various scenarios that the asset price might follow over the option's life.

B is incorrect: This is a correct use of Monte Carlo simulation. The average of the discounted payoffs from the simulated paths provides an estimate of the fair value of the lookback option.

CFA Level I, Volume 1, Topic 3 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7b: describe Monte Carlo simulation and explain how it can be used in investment applications.

Q.4602 Which of the following statements **best** describes the purpose of resampling in statistical analysis?

- A. Resampling involves repeatedly using the same sample to test different hypotheses without making any statistical inferences about the population.
- B. Resampling is a method used exclusively for estimating the mean of a population by drawing multiple samples from the observed data.
- C. Resampling entails repeatedly drawing samples from the original observed sample to make statistical inferences about population parameters.

The correct answer is **C**.

Resampling methods, like Bootstrap, involve drawing multiple samples from the original observed sample to estimate population parameters and assess the variability of these estimates.

A is incorrect: Resampling is specifically used to make statistical inferences about population parameters, not just to test different hypotheses without making inferences.

B is incorrect: While resampling can be used to estimate the mean of a population, it is not exclusively used for this purpose. Resampling methods, such as Bootstrap and jackknife, can be used to make inferences about various population parameters, not just the mean.

CFA Level I, Volume 1, Topic 4 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7c: describe the use of bootstrap resampling in conducting a simulation based on observed data in investment applications.

Q.4603 Which of the following statements is ***most accurate***? Bootstrap resampling technique:

- A. treats the initial sample as a stand-in for the entire population, allowing for the creation of a sampling distribution through repeated resampling.
- B. requires conventional analytical formulas like z-statistics to create a sampling distribution for statistical inferences.
- C. information about the population is essential to mimic the process of drawing samples from the population.

The correct answer is **A**.

This statement accurately describes the Bootstrap resampling technique. The method treats the initially obtained sample as a stand-in for the entire population and creates a sampling distribution by repeatedly resampling from the initial sample.

B is incorrect: Bootstrap resampling bypasses the need for conventional analytical formulas like z-statistics. It relies on computer simulations to create a sampling distribution for statistical inferences.

C is incorrect: In Bootstrap resampling, we do not have information about the population. Our only insight comes from a sample drawn from the "unknown population." The technique relies on the sample to mimic the process of drawing samples from the population.

CFA Level I, Volume 1, Topic 4 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7c: describe the use of bootstrap resampling in conducting a simulation based on observed data in investment applications.

Q.4604 Which of the following statements **best** distinguishes between the Bootstrap and Monte Carlo simulation techniques?

- A. Both techniques use repetitive sampling for statistical inferences but differ in their data generation and usage approaches.
- B. Monte Carlo uses the dataset as a proxy for the population, whereas Bootstrap resampling requires pre-determined parameter distributions.
- C. Monte Carlo simulation needs many observations for accurate population simulation, whereas Bootstrap can effectively handle smaller datasets.

The correct answer is **A**.

This statement accurately distinguishes between the two techniques. Bootstrap focuses on inferring population parameters from resampled datasets, while Monte Carlo simulation centers on generating random data with specified statistical distributions.

B is incorrect: It incorrectly reverses the characteristics of the two techniques. Bootstrap uses the resampled dataset as a proxy for the true population, while Monte Carlo simulation generates random data with pre-determined statistical distributions.

C is incorrect: This statement incorrectly attributes the characteristics of Bootstrap to Monte Carlo simulation and vice versa. Bootstrap infers population parameters from resampled datasets, while Monte Carlo simulation involves generating random data with pre-determined statistical distributions.

CFA Level I, Volume 1, Topic 4 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7c: describe the use of bootstrap resampling in conducting a simulation based on observed data in investment applications.

Q.4605 In the process of bootstrapping, analysts:

- A. are required to define probability distributions for crucial risk factors influencing the underlying random variables.
- B. continuously draw samples of identical size, with replacement, from the initial population.
- C. aim to derive statistical estimates of population parameters using a singular sample.

The correct answer is **C**.

Analysts use a single sample to generate multiple resampled datasets, from which they infer the statistical properties of the population.

B is incorrect: Analysts draw samples of the same size, with replacement, not from the original population but from the original sample. This is a key aspect of bootstrapping, as it uses the sample as a proxy for the population.

A is incorrect: One of the advantages of bootstrapping is that it does not require the specification of probability distributions for the underlying random variables or risk factors. Instead, it relies on the empirical distribution of the sample data.

CFA Level I, Volume 1, Topic 4 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7c: describe the use of bootstrap resampling in conducting a simulation based on observed data in investment applications.

Q.4606 Which of the following ***accurately*** describes an advantage of the bootstrapping method? Bootstrapping:

- A. yields precise outcomes for population parameters.
- B. is intricate and demands comprehensive statistical expertise.
- C. can emulate sampling from the population by utilizing the observed.

The correct answer is C.

Bootstrapping allows for the emulation of population sampling through the observed sample, effectively representing the statistical characteristics of the population.

A is incorrect: Bootstrapping generates statistical approximations, not precise outcomes. It's a resampling technique used to estimate population parameters.

B is incorrect: A notable advantage of bootstrapping is its simplicity. It's relatively easy to implement compared to other statistical methods.

CFA Level I, Volume 1, Topic 4 - Quantitative Methods, Learning Module 6, Simulation Methods, LOS 7c: describe the use of bootstrap resampling in conducting a simulation based on observed data in investment applications.
