

## **Learning Module 8: Pricing and Valuation of Options**

Q.1041 Consider a call option on a stock currently selling at \$95/share, and with a strike price of \$ 90/share. By how much is this option in the money or out of the money?

- A. \$5 at the money.
- B. \$5 in the money.
- C. \$5 out of the money.

The correct answer is **B**.

The call is \$5 in the money because the strike price is less than the current market price.

$$S - X = \$5$$

In these circumstances, the buyer stands to make a profit of \$5 if they decide to exercise the option (ignoring the premium paid).

**A is incorrect.** If the strike price is almost equal to spot price, then the option is considered to be at the money.

**C is incorrect.** If the strike price is more than the current market price the call option is considered to be out the money.

***CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.***

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Q.1042 Consider a November 110 put on a stock currently selling at \$115/share. The option is:

- A. \$5 in the money.
- B. \$5 at the money.
- C. \$5 out of the money.

The correct answer is **C**.

The put is \$5 out of the money because the current market price is greater than the strike price.

$$X - S = -\$5$$

In these circumstances, the buyer of the option would have no incentive to exercise the option.

**A is incorrect.** If the strike price is more than the current market price the call option is considered to be out the money.

**B is incorrect.** If the strike price is almost equal to spot price, then the option is considered to be at the money.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.1043 Which of the following relationships is *most likely* correct?

- A. Option Premium = Intrinsic Value - Time Value.
- B. Option Premium = Time Value - Intrinsic Value.
- C. Option Premium = Intrinsic Value + Time Value.

The correct answer is **C**.

$$\text{Option Premium} = \text{Intrinsic Value} + \text{Time Value.}$$

The intrinsic value of an option represents the current value of the option. It's the difference between the price of the underlying asset and the strike price of the option. In other words, it's the option's moneyness.

The time value of an option is an additional amount the investor is willing to pay over the current intrinsic value. The investor is willing to pay this in cognizance of the possibility that the option will increase in value before its expiration date.

**A is incorrect.** It suggests that the option premium is calculated by subtracting the time value from the intrinsic value, which is not accurate. The intrinsic value and time value are not opposing forces in the calculation of an option's premium; rather, they are additive. The intrinsic value represents the current, tangible value of the option, while the time value represents the potential for additional value before expiration. Subtracting the time value from the intrinsic value would not provide a meaningful measure of the option's worth.

**B is incorrect.** It represents the option's immediate exercisable value. The time value is considered an extra cost that investors are willing to pay for the possibility of the option gaining value over time, not a primary value from which the intrinsic value is subtracted.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.1044 Which of the following is *least likely* a factor that determines the value of an option?

- A. The inflation rate.
- B. The price of the underlying asset.
- C. The volatility of the underlying asset.

The correct answer is **A**.

Both the price and the volatility of the underlying asset play an important role in determining the value of an option. The exercise price is directly proportional to the value of a put option and inversely proportional to the value of a call option. Volatility is directly proportional to the value of both call and puts options.

The risk-free rate, not the inflation rate, is directly proportional to the value of a call option and inversely proportional to the value of a put option.

**B is incorrect.** The price of the underlying asset is one of the most critical determinants of an option's value. For a call option, as the price of the underlying asset increases, the value of the option typically increases. Conversely, for a put option, as the price of the underlying asset decreases, the value of the option typically increases. This direct relationship between the price of the underlying asset and the option's value is fundamental to options pricing.

**C is incorrect.** Volatility measures the degree of variation in the price of the underlying asset over time. Higher volatility increases the probability that the option will end up in-the-money by expiration, thereby increasing its value. This applies to both call and put options. Volatility is a critical component in options pricing models because it reflects the underlying asset's risk level.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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Q.1046 A deep out-of-the-money option is *most likely* priced:

- A. At its time value.
- B. Under its time value.
- C. Higher than its time value.

The correct answer is **A**.

A deep out of the money call (put) option is an option whose strike price is greater (less) than the current market price of the underlying.

An option's value has 2 components: (1) time value and (2) intrinsic value. A deep out-of-the-money option is priced at its time value since the intrinsic value is close to zero. The time value of an option measures the benefits of holding an option with the time remaining to maturity with some chance that the price of the underlying will move towards the desired strike price.

The time value of an option reduces as the option nears its expiry date. Even though a deep out of the money option appears worthless, its time value means that the derivative still has some value. Some investors are willing to pay some money for the remaining time value. Such options will therefore be priced at their time value.

**B is incorrect.** This option suggests that a deep out-of-the-money option would be priced under its time value. This is not possible since the intrinsic value is zero or close to zero, and the option's entire worth is derived from its time value. Pricing it under its time value would imply the option has negative value, which contradicts the principles of option pricing.

**C is incorrect.** Suggesting that a deep out-of-the-money option is priced higher than its time value implies there is additional value beyond the time value, which is not the case. The intrinsic value is zero, and the time value is the only component contributing to the option's price. Therefore, it cannot be priced higher than its time value without contradicting the fundamental principles of how options are valued.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.1047 What is the *most likely* result of a decrease in the risk-free rate of return on put and call option prices?

- A. Both put and call prices will increase.
- B. Put option prices will decrease while call option prices will increase.
- C. Put option prices will increase while call option prices will decrease.

The correct answer is **C**.

The result of a decrease in the risk-free rate of interest will increase put option prices and decrease call option prices.

A call option can be looked at as the right to delay a purchase. The higher the interest rate you can earn on the cash you will use to make the purchase, the greater the benefit of being able to delay it.

A put option can be looked at as the right to delay a sale. The higher the interest rate you can earn on the cash generated from the sale, the less desirable it is to delay it.

**A is incorrect.** This option suggests that both put and call prices will increase with a decrease in the risk-free rate. While it is true that put option prices increase, call option prices actually decrease for the reasons explained above. The differential impact on put and call options is a direct consequence of how each option's value is influenced by changes in the risk-free rate.

**B is incorrect.** This option states that put option prices will decrease while call option prices will increase with a decrease in the risk-free rate. This is the opposite of the actual relationship between risk-free rates and option prices. As explained, a decrease in the risk-free rate makes put options more valuable (due to the lower opportunity cost of holding cash) and call options less valuable (due to the reduced benefit of deferring the purchase of the underlying asset).

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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Q.1146 Which of the following *best* describes the obligation of the writer of a put option?

- A. To sell the option at its strike price if the option is exercised.
- B. To buy the underlying security at the option's strike price if the option is exercised.
- C. To sell the underlying security at the option's strike price if the option is exercised.

The correct answer is **B**.

When you write (sell) a put option, you receive the premium and, in exchange, have the obligation to purchase the underlying security at the option's strike price if the buyer decides to exercise the option.

The buyer of an option (either a call or a put) has “the right to transact, but not the obligation” whereas the writer (seller) of an option has an obligation.

**A is incorrect.** This option describes the obligation of the writer of a call option, not a put option. In the case of a call option, the writer is obligated to sell the underlying security at the option's strike price if the option is exercised by the buyer. This is fundamentally different from the obligation associated with writing a put option, where the writer must buy the underlying security.

**C is incorrect.** This choice also inaccurately describes the obligation of a put option writer. It mistakenly suggests that the writer of a put option must sell the underlying security at the option's strike price if the option is exercised. This misunderstanding could lead to confusion about the roles and responsibilities in options trading, where clear distinctions between the types of options and their respective obligations are crucial for effective market participation.

***CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.***

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Q.1153 If the spot price is less than the strike price of a call option on the underlying, the option is said to be:

- A. In-the-money.
- B. At-the-money .
- C. Out-of-the-money.

The correct answer is **C**.

If the exercise of an option generates a negative value, then the option is out of the money. For instance assume that the spot price is \$50 and the strike price is \$55. In this case, exercising the call option implies that the option holder will have to spend \$55 to buy the underlying, but they can only get \$50 if they decide to sell it in the open market.

**A is incorrect.** An in-the-money (ITM) call option is characterized by a strike price that is lower than the current market price of the underlying asset. This means that if the option were exercised, the holder could buy the asset at a price below the market value, potentially resulting in an immediate profit if sold at the current market price.

**B is incorrect.** An at-the-money (ATM) call option occurs when the strike price and the current market price of the underlying asset are equal. This means the option holder would neither gain nor lose money if they were to exercise the option and immediately sell the asset at the market price (ignoring transaction costs and premiums paid for the option).

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.1156 Which condition will *most likely* increase the value of a call option?

- A. A decrease in volatility.
- B. A decrease in stock price.
- C. An increase in the risk-free rate.

The correct answer is **C**.

An increase in any/all of the risk-free rate, volatility, or the stock price will increase the value of a call option.

**A is incorrect.** A decrease in volatility generally leads to a decrease in the value of a call option. Volatility is a measure of the stock's price fluctuations. Higher volatility increases the probability that the stock price will hit higher highs, which is beneficial for a call option since it gives the option holder the right but not the obligation to buy the stock at a predetermined price. Lower volatility means there is less chance of the stock price moving significantly, which reduces the potential upside and, consequently, the value of the call option.

**B is incorrect.** A decrease in the stock price typically leads to a decrease in the value of a call option. The intrinsic value of a call option is calculated as the current stock price minus the strike price (the price at which the option holder can buy the stock), provided this difference is positive. If the stock price decreases, the difference between the stock price and the strike price narrows (or becomes negative), reducing the intrinsic value of the call option. Since the value of a call option is partly derived from its intrinsic value, a decrease in the stock price generally results in a lower call option value.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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Q.1160 Which of the following options on assets that have cash flows during the term of the option will *most likely* have the greater price?

- A. Fiduciary option.
- B. American option.
- C. European option.

The correct answer is **B**.

An American option is exercisable at any time before and on the expiration date. This increases its buying price when compared to an European option that is only exercisable on the expiration date.

**A is incorrect.** The term "fiduciary option" does not directly apply to the context of options pricing in the manner described by the question. Fiduciary duties refer to the responsibilities that one party has to another in a relationship of trust. While fiduciary principles might influence the behavior of parties in financial transactions, they do not constitute a type of option or directly impact option pricing in the way that the exercise rights of American or European options do.

**C is incorrect.** A European option, which can only be exercised on the expiration date, lacks the flexibility of an American option. This limitation generally results in a lower price compared to an American option for assets that have cash flows during the term of the option. The inability to exercise the option early and capture cash flows such as dividends reduces the European option's value. While European options might be preferred for their simplicity and potentially lower cost, they do not offer the same level of strategic flexibility as American options, which is a critical factor in pricing.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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Q.3347 Hailey Moore, a derivatives expert, made the following comments during a meeting with her fellow colleagues: Comment 1: "Call options are very lucrative investments since they offer the buyer unlimited gains and a limited loss potential." Comment 2: "Selling a call option, without taking offsetting positions, is probably the worst investment strategy since it exposes the investor to unlimited losses." Which of the following would *most likely* refute the aforementioned conclusions presented by Moore?

- A. Frequently closing out positions.
- B. Changing frequencies with which gains and losses occur.
- C. Most options being deep-in-the-money or deep out-of-money.

The correct answer is **B**.

Changing the frequency with which gains and losses occur can significantly impact the perceived benefits and risks associated with call options, thus refuting Hailey Moore's conclusions. Moore's first comment highlights the lucrative aspect of buying call options due to their structure of offering unlimited gains while limiting losses to the premium paid. This characteristic indeed makes call options attractive to investors who are bullish on the underlying asset. However, the frequency of gains and losses plays a crucial role in determining the actual profitability of engaging in call options. If the underlying asset's price does not increase above the strike price frequently enough to cover the cost of the premiums for the options that expire worthless, the strategy may not be as lucrative as suggested.

**A is incorrect.** Frequently closing out positions does not directly refute Moore's conclusions about the nature of call options. While managing and closing positions can be part of a broader strategy to mitigate risks or lock in gains, it does not inherently change the fundamental characteristics of call options that Moore describes. The decision to close out positions frequently is more about tactical execution rather than a fundamental critique of the investment strategy itself.

**C is incorrect.** The fact that most options being deep-in-the-money or deep out-of-money does not directly challenge Moore's conclusions. While the moneyness of an option at expiration can affect the outcome for the option holder or writer, Moore's comments are more focused on the inherent structure and risk/reward profile of call options in general. Whether an option is deep-in-the-money or deep out-of-money affects the value and potential profitability of specific positions but does not refute the general advantages and disadvantages of buying or selling call options as described by Moore.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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Q.3360 The value of European call option is:

- A. Inversely related to the exercise price and the value of the underlying.
- B. Directly related to the time to the expiration and the value of the underlying.
- C. Directly related to the exercise price and inversely related to the value of the underlying.

The correct answer is **B**.

The value of a call option is directly related to the time to expiration. That means the call's value increases as the time to expiration increases. Over a longer duration, there is a greater chance that the spot price will rise above the exercise price.

The value of a call is also directly related to the value of the underlying. This means that the option's value increases with an increase in the price of the underlying and vice versa. That's because a call option is equivalent to buying the underlying.

However, there is an inverse relationship between a call option's value and its exercise price. As the exercise price increases, the call's value decreases and vice versa. As the exercise increases, the chances of the call being in-the-money at expiration decrease because the underlying would have to show even more positive price movement.

**A is incorrect.** This option suggests that the value of a European call option is inversely related to both the exercise price and the value of the underlying asset. While it is true that the value of a call option is inversely related to the exercise price (meaning the call option's value decreases as the exercise price increases), it is directly related to the value of the underlying asset. An increase in the value of the underlying asset increases the likelihood that the call option will be in-the-money at expiration, thereby increasing its value.

**C is incorrect.** It increases the likelihood that the option will be in-the-money at expiration.

***CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.***

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Q.3363 James Porter is analyzing the following option contracts on a security with a current market price of \$20

Call Options	Exercise Price	Time to Expiration
A	\$25	36 months
B	\$29	8 months
C	\$30	22 months

Which of the above option contracts is *most likely* to have the lowest premium?

- A. Call A.
- B. Call B.
- C. Call C.

The correct answer is **B**.

Call option B has a higher exercise price and a lower time to expiration than option A. Even though its exercise price is slightly lower than that of Option C, the latter has a much longer time to expiration, and hence, is more expensive.

Note: Exercise price is inversely proportional to the value of a call option. As the exercise price increases, the value of a call option decreases and vice versa. Time to expiration is directly proportional to the value of a call option. A longer time to expiration implies more potential for price movements, thereby increasing the option's value. The opposite is true.

**A and C are incorrect.** As explained above.

***CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.***

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Q.3365 An American style put option on a bond expires in 80 days and has an exercise price of \$0.90 per \$1 of par. The bond is currently worth \$1.20 per \$1 par and makes no cash payments during the life of the option. The risk-free rate of interest is 3.5%, and the notional principal of the contract is \$1,000. The bond is expected to be worth \$1.40 per \$1 par at option expiration. The highest and lowest possible prices (per \$1 par value) for the put option are respectively *closest to*:

- A. Highest price: \$0.89; Lowest price: \$0.20.
- B. Highest price: \$0.90; Lowest price: \$0.00.
- C. Highest price: \$1.40; Lowest price: \$1.20.

The correct answer is **B**.

The maximum value of an American put is the exercise price, \$0.90 per 1 par value while the minimum value of any option is 0.

**A is incorrect.** It suggests that the highest price for the put option could be \$0.89, which is less than the exercise price of \$0.90. This does not align with the principle that the maximum value of an American put option can be its exercise price.

**C is incorrect.** These values do not align with the principles of option pricing. The highest price cannot exceed the exercise price for a put option, and the lowest price cannot be greater than 0.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.3378 Which of the following conditions will make a long-term European put option worth more than an otherwise identical short-term put option?

- A. The volatility in the market is low.
- B. Interest rates are lower than they have ever been in the past.
- C. Interest rates are higher than they have ever been in the past.

The correct answer is **B**.

A long-term European put option will be worth a lot more than an otherwise identical short-term put option if interest rates are lower and volatility is higher. Since European options can only be exercised on their expiration date, a longer time to expiration suggests that the option holder will need to wait longer to receive money from the sale of the underlying. The lost interest will be a disadvantage of the additional time; lower interest rates will reduce this lost interest. Higher volatility will increase the chances that the underlying price will move in favor of the option holder.

**A is incorrect.** The volatility of the market is a critical factor in determining the value of options. Higher volatility increases the potential for the underlying asset's price to move significantly, which can increase the value of options, including put options. Therefore, low volatility would not make a long-term European put option worth more than an identical short-term put option. In fact, higher volatility is generally favorable for the value of long-term options, as it increases the chances of the option ending in the money.

**C is incorrect.** The cost of carrying or holding an option (the opportunity cost of not investing the funds at the risk-free rate) increases with higher interest rates. For long-term options, this cost is more significant due to the longer period until expiration. Therefore, higher interest rates would not make a long-term European put option more valuable than an otherwise identical short-term option; it would likely have the opposite effect.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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Q.3381 An investor purchases a European put option that is deep in the money. Increasing the risk-free rate and time to expiration will have an effect on the value of the option, that is:

- A. Neutral.
- B. Positive.
- C. Negative.

The correct answer is **C**.

Increasing the risk-free rate and time to expiration for a European put option that is deep in the money generally has a negative effect on the option's value. Recall that a put option that is deep in the money means that the strike price is significantly above the current market price of the underlying asset.

An increase in the risk-free interest rate tends to decrease the value of a put option. This is because the risk-free rate is a component of the option pricing models, such as the Black-Scholes model. Higher risk-free rates increase the cost of carrying the underlying asset, as it becomes more expensive to hold the asset when the returns from risk-free investments are higher. This makes the put option less attractive, as the opportunity cost of holding the asset rather than investing in risk-free securities increases. Additionally, the present value of the option's payoff decreases as the risk-free rate rises because the future payoff is discounted back at a higher rate.

Similarly, increasing the time to expiration can have a complex effect on the value of a deep-in-the-money put option. While longer time frames generally increase the value of options due to the higher uncertainty and potential for the underlying asset's price to move in a favorable direction, for deep in-the-money put options, this effect might be offset by the time value decay and the increased cost of carry. The net effect tends to be negative, as the benefits of having more time for the asset price to decrease further (which would be beneficial for a put option) are outweighed by the costs associated with holding the option for a longer period.

**A is incorrect.** Suggesting that the effect is neutral overlooks the impact of the risk-free rate and time to expiration on the option's value. The risk-free rate affects the cost of carry and the present value of the option's payoff, while the time to expiration influences the option's time value and the uncertainty regarding the underlying asset's future price movements.

**B is incorrect.** Indicating a positive effect contradicts the principles of option pricing. While certain factors, such as an increase in the underlying asset's volatility, could increase a put option's value, an increase in the risk-free rate and time to expiration for a deep in-the-money European put option generally leads to a decrease in its value due to the reasons explained above.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS c: Identify the factors that determine the value of an option and describe how each factor affects the value of an option**

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Q.3382 Consider two otherwise identical 3-month European call and put options on BBT Company's stock. Who will benefit *most* from an increase in carrying costs?

- A. The call option issuer.
- B. The put option holder.
- C. The call option holder.

The correct answer is **C**.

A call option holder will benefit from an increase in carrying costs. Holding the call option will enable the investor to participate in the movements of the underlying without having to incur these costs.

**A is incorrect.** On the other hand, a call option issuer will hold the underlying and bear the costs associated with storing an asset.

**B is incorrect.** Similarly, holding put options will make it more expensive to participate in movements of the underlying than by short selling because short sellers benefit from carrying costs, which are borne by owners of the asset.

***CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.***

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Q.3390 The value of a European put option will increase with higher:

- A. Volatility.
- B. Carrying costs.
- C. Risk-free interest rates.

The correct answer is **A**.

Higher volatility will increase the value of a European put option because it increases the chances of the underlying price declining relative to the exercise price.

**B is incorrect.** Carrying costs will raise the effective cost of holding or shorting the asset. Holding put options will make it more expensive to participate in the movements of the underlying than by short selling because short sellers benefit from carrying costs, which are borne by the owners of the assets.

**C is incorrect.** A higher risk-free interest rate will lower the present value of the amount received once the option is exercised. This will decrease the value of the European put.

***CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.***

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Q.4182 Which of the following is *most likely* true regarding a call option replication strategy only?

- A. At option contract inception, borrow at a risk-free rate and then utilize the proceeds to buy the underlying asset at a price at the option inception.
- B. At option contract inception, lend an amount equal to the option's exercise value at a risk-free rate and sell the underlying at a price at the option inception.
- C. The replication strategy requires adjustment over time depending on the likelihood of option exercise.

The correct answer is **A**.

Replication of a call option at the contract initiation involves borrowing at a risk-free rate,  $r$ , and then utilizing the proceeds to buy the underlying asset at a price of  $S_0$ .

At the expiration date ( $t = T$ ), there exist two replication outcomes:

- If  $S_T < X$ , exercise the option: sell the underlying at  $S_T$  and use the proceeds to repay the risk-free loan.
- If  $S_T > X$ , no exercise: no settlement is needed.

**B is incorrect.** It describes the replication strategy in put options. Replication of a put option at the contract initiation involves selling the underlying short at a price of  $S_0$  and lending the proceeds at the risk-free rate,  $r$ .

**C is incorrect.** Adjustments are required over time in both call and put option replication strategies based on the likelihood of exercise.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (b): Contrast the use of arbitrage and replication concepts in pricing forward commitments and contingent claims.**

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Q.4183 Consider a one-year call option with an exercise price of \$100 and a risk-free rate of 1.5%. If after six months, the spot price of the underlying is \$105, the exercise value of the option after six months is *closest to*:

- A. \$0
- B. \$0.74
- C. \$5.74

The correct answer is **C**.

The exercise value of a call option is the value of an option contract at any time  $t < T$ , and it is calculated as spot price ( $S_t$ ) minus the present value of the exercise price:

$$\begin{aligned}c_t &= \text{Max}(0, S_t - X(1 + r)^{-(T-t)}) \\&= \text{Max}(0, 105 - 100(1.015)^{-0.5}) \\&= \text{Max}(0, 105 - 99.258) = \$5.74\end{aligned}$$

**A is incorrect.** It assumes that the option in question is the put option so that,

$$\begin{aligned}p_t &= \text{Max}(0, S_t - X(1 + r)^{-(T-t)}) \\&= \text{Max}(0, 100(1.015)^{-0.5} - 105) \\&= \text{Max}(0, -5.74) = \$0\end{aligned}$$

**B is incorrect.** It uses only the exercise price in the calculation as follows:

$$\begin{aligned}c_t &= \text{Max}(0, S_t - X(1 + r)^{-(T-t)}) \\&= \text{Max}(0, 100 - 100(1.015)^{-0.5}) \\&= \text{Max}(0, 100 - 99.258) = \$0.74\end{aligned}$$

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.4184 A one-year put option has an exercise value of \$99. After six months, the underlying spot price is \$96, and the observable price of the put option is \$4.5. Assuming the risk-free rate is 1%, the time value of the put option six months to maturity is *closest to*:

- A. \$1.99
- B. \$2.51
- C. \$7.01

The correct answer is **A**.

Denote the current price for a put option at any time  $T = t$  by  $p_t$ . The time value of an option is defined as the difference between the current option price and the option's current payoff (or exercise value):

$$\begin{aligned}\text{Time Value} &= p_t - \text{Max}(0, X(1+r)^{-(T-t)} - S_t) \\ &= 4.5 - \text{Max}(0, 99(1.01)^{-0.5} - 96) \\ &= 4.5 - \text{Max}(0, 2.51) \\ &= 4.50 - 2.51 = \$1.99\end{aligned}$$

**B is incorrect.** It represents the current payoff of the put option after six months.

$$\begin{aligned}\text{Payoff of the put option after six months} &= \text{Max}(0, X(1+r)^{-(T-t)} - S_t) \\ &= \text{Max}(0, 99(1.01)^{-0.5} - 96) = \$2.51\end{aligned}$$

**C is incorrect.** It calculates the time value of the put option as the sum of the current option price and the option's current payoff (or exercise value)

$$\begin{aligned}\text{Time Value} &= p_t + \text{Max}(0, X(1+r)^{-(T-t)} - S_t) \\ &= 4.5 + \text{Max}(0, 99(1.01)^{-0.5} - 96) \\ &= 4.5 + \text{Max}(0, 2.51) \\ &= 4.50 + 2.51 = \$7.01\end{aligned}$$

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.4185 A European call option on a non-dividend paying stock has 4 months to maturity. The exercise price of the option is \$100, and the risk-free rate is 1.5%. If the current underlying price is \$105 and the current call option price is \$6.5, the time value of the call option is *closest to*:

- A. \$1.00
- B. \$5.50
- C. \$12.00

The correct answer is **A**.

Denote the current price for a call option at any time  $T = t$  by  $c_t$ . The time value of an option is defined as the difference between the current option price and the option's current payoff (or exercise value):

$$\begin{aligned}\text{Time Value} &= c_t - \text{Max}(0, S_t - X(1 + r)^{-(T-t)}) \\ &= 6.5 - \text{Max}(0, 105 - 100(1.015)^{-0.3333}) \\ &= 6.5 - \text{Max}(0, 5.50) \\ &= 6.50 - 5.50 = \$1.00\end{aligned}$$

**B is incorrect.** It represents the current payoff of the put option after four months.

$$\begin{aligned}\text{Max}(0, S_t - X(1 + r)^{-(T-t)}) &= \text{Max}(0, 105 - 100(1.015)^{-0.3333}) \\ &= \$5.50\end{aligned}$$

**C is incorrect.** It calculates the time value of the call option as:

$$\begin{aligned}\text{Time Value} &= c_t + \text{Max}(0, S_t - X(1 + r)^{-(T-t)}) \\ &= 6.5 + \text{Max}(0, 105 - 100(1.015)^{-0.3333}) \\ &= 6.5 + \text{Max}(0, 5.50) \\ &= 6.50 + 5.50 = \$12.00\end{aligned}$$

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.4186 Which of the following is *most likely* a consequence of a lower no-arbitrage bound at any time before maturity?

- A. A call option is exercisable if the underlying price exceeds the exercise price.
- B. A call option is exercisable if the underlying price is less than the exercise price.
- C. A call option buyer will not pay more than the underlying price for the right to buy the underlying.

The correct answer is **A**.

A call option is exercisable if the underlying price exceeds the exercise price. That is  $S_t > X$ . As such, the lower bound of a call price is the underlying price minus the present value of the exercise price or zero, whichever is greater. Put into the equation:

$$\text{Lower Bound} = \text{Max}(0, S_t - X(1 + r)^{-(T-t)})$$

**B is incorrect.** It is associated with the no-arbitrage upper bound.

**C is incorrect.** It is a consequence of the upper no-arbitrage upper bound of a call option. A call buyer will not pay more than the underlying price for the right to buy the underlying. As such, the upper bound is the current underlying price.

$$\text{Upper bound} = S_t$$

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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Q.4187 Consider a one-year put option with an exercise price of USD 100 and a risk-free rate of 1%. If, after six months, the spot price of the underlying is USD 98.50, the no-arbitrage upper and lower bounds are *closest to*:

- A. Lower bound = 0.51; Upper bound = \$100.
- B. Lower bound = 1.00; Upper bound = \$100.
- C. Lower bound = 0.51; Upper bound = \$98.50.

The correct answer is **B**.

A call option buyer exercises a put option only if  $S_T < X$ . As such, the upper bound on the put value is thus the exercise price.

$$\text{Upper Bound} = X = 100$$

The lower bound is the present value of the exercise price minus the spot price or zero, whichever is greater:

$$\text{Lower bound} = \text{Max}(0, 100(1.01)^{-(0.5)} - 98.5) = \$1.00$$

**A is incorrect.** It assumes that the no-arbitrage lower bound is the current payoff of the put option.

**C is incorrect.** It assumes that the no-arbitrage lower bound is the current payoff of the put option, and the upper bound is the current underlying price.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (a): Explain the exercise value, moneyness, and time value of an option.**

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Q.4188 Which of the following factors *most likely* have the same effect on both the call and put options?

- A. Increase in the risk-free rate.
- B. Decrease in exercise price.
- C. Increase in the volatility of the underlying price

The correct answer is **C**.

An increase in volatility will increase the value of both call and put options. Higher volatility of the underlying asset increases the chances of a higher positive exercise value without affecting the downside case – the option expires worthless. For instance, as volatility increases, a broader possibility of underlying prices increases the time value of an option and the likelihood of being in the money.

**A is incorrect.** The value of a call option at any time before maturity ( $t < T$ ) is given by

$$c_t = \text{Max}(0, S_t - X(1 + r)^{-(T-t)})$$

A higher risk-free rate increases the value of the call option. This is because a higher risk-free rate lowers the present value of the exercise price, provided the option is in the money. For a put option, its value at any time before maturity ( $t < T$ ) is given by:

$$p_t = \text{Max}(0, X(1 + r)^{-(T-t)} - S_t)$$

As such, a higher risk-free rate decreases the exercise value of a put option due to the same explanation in the call option.

**B is incorrect.** The exercise price determines whether an option buyer will exercise the option at the expiration. Remember that the payoff of a call option at maturity is  $\text{Max}(0, S_T - X)$ . Intuitively, a lower exercise price will increase both the likelihood of exercise and settlement value if it is in the money.

For the put option, the exercise price is the upper bound of the option price. Moreover, the payoff of a put option is  $\text{Max}(0, X - S_T)$ . As such, a high exercise price increases the value of the put option.

**CFA Level I, Derivatives, Learning Module 8: Pricing and Valuation of Options. LOS (c): Identify the factors that determine the value of an option and describe how each factor affects the value of an option.**

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