7. Derivatives

7.1. Derivatives Market and Instruments

7.1.1. 重要知识点

7.1.1.1. 衍生品的定义: **A derivative is a financial instrument (contract) that derives its performance from the performance of an underlying asset.**

7.1.1.2. 衍生品分类方法

➢ 根据合约特点分类：**forward commitment & contingent claim**

- Forward commitment (firm commitment, **linear** derivatives with **symmetric payoff** profile): is an agreement between two parties in which one party, the buyer, agrees to buy from the other party, the seller, an underlying asset at a future date at a price established at the start → forward, futures and swap contracts

- Contingent claim (**non-linear** derivatives with **asymmetric payoff** profile): is derivative in which the payoffs occur if a specific event happens → option contracts, embedded derivative.

  - ◆ Credit default swaps (CDS) is essentially an insurance contract for the reference, the reference obligation is the fixed income security on which the swap is written-usually a bond but potentially also a loan.

  - ◆ The protection buyer pays the seller a premium. The default swap premium is also referred to as the **CDS spread**.

  - ◆ Protection buyer receives a payment from the protection seller if default occurs on the reference entity.

  - ◆ **An embedded derivative** is a derivative within an underlying, such as a callable, puttable, or convertible bond.

➢ 根据交易场所分类： **exchange-traded & over-the-counter traded**

- Exchange-traded: 在一个固定的交易所交易。多空双方不直接见面，与清算所交易。（A—>Clearinghouse—>B）

- OTC traded: 没有固定交易场所，多空双方直接交易。（A—>B）

Exchange-traded	Over-the-counter
Standardized —> Liquid	Customized/Specific needs
Backed by a clearinghouse	Trade with counterparty (default risk)
Trade in a physical exchange	Not trade in organized markets
Regulated	Unregulated

  - ◆ Market makers: buy at one price (the bid), sell at a higher price (the ask).

7.1.2. 基础题

Q-1. Which of the following derivatives is least likely to be classified as a contingent claim?

A. A futures contract

B. A call option contract

C. A credit default swap

Q-2. In contrast to over-the-counter options, futures contracts most likely:

A. are not exposed to default risk.

B. represent a right rather than a commitment.

C. are private, customized transactions

Q-3. Which of the following is least likely to be an example of a derivative?

A. An exchange-traded fund

B. A contract to sell Alphabet Inc.'s shares at a fixed price

C. A contract to buy Australian dollars at a predetermined exchange rate

Q-4. Which of the following statement is most likely incorrect?

A. ETD markets use standardized contracts.

B. OTC markets use market maker while ETD markets do not.

C. OTC markets have greater confidentiality than ETD markets.

7.2. Benefits and risks of derivative instruments

7.2.1. 重要知识点

7.2.1.1. Benefits and risks of derivative instruments

> **Benefits**

Purpose	Description
Risk Allocation, Transfer, and Management	Allocate, trade, and/or manage underlying exposure without trading the underlying. Create exposures unavailable in cash markets.
Information Discovery	Deliver expected price in the future as well as expected risk of underlying
Operational Advantages	Reduced cash outlay, lower transaction costs versus the underlying, increased liquidity and ability to "short"
Market Efficiency	Less costly to exploit arbitrage opportunities or mispricing

> **Risk**

Risk	Description

Greater Potential for Speculative Use	High degree of implicit leverage may increase the likelihood of financial distress.
Lack of Transparency	Derivatives add portfolio complexity and may create an exposure profile that is not well understood.
Basis Risk	Potential divergence between the expected value of a derivative instrument versus an underlying or hedged transaction, e.g., Issuer CDS spread v.s. actual bond
Liquidity Risk	Potential divergence between the cash flow timing of a derivative instrument versus an underlying or hedged transaction.
Counterparty Credit Risk	Derivative instruments often give rise to counterparty credit exposure, resulting from differences in the current price versus the expected future settlement price.
Destabilization and Systemic Risk	Excessive risk taking and use of leverage may contribute to market stress, e.g., 2008 financial crisis.

7.2.2. 基础题

Q-5. Which of the following is not an advantage of derivative markets?

A. They are less volatile than spot markets

B. They facilitate the allocation of risk in the market

C. They incur lower transaction costs than spot markets

Q-6. Derivatives can be used to:

A. improve the allocation of risk and facilitate more effective risk management.

B. make short-selling more difficult.

C. consistently generate long-term excess returns on a risk-adjusted basis.

7.3. Issuer & Investor Use of Derivatives

7.3.1. 重要知识点

7.3.1.1. Issuer Use of Derivatives

➢ Issuers predominantly use derivatives to offset or hedge market-based underlying exposures incidental to their commercial operations and financing activities.

➢ Hedge accounting allows an issuer to offset a hedging instrument (usually a derivative) against a hedged transaction or balance sheet item to reduce financial statement volatility.

Hedge Accounting Types		Description Examples
Cash Flow	Absorbs variable cash	✓ Interest rate swap to a fixed

	flow of floating-rate asset or liability (forecasted transaction)	rate for floating-rate debt ✓ FX forward to hedge forecasted sales
Fair Value	Offsets fluctuation in fair value of an asset or liability	✓ Interest rate swap to a floating rate for fixed-rate debt ✓ Commodity future to hedge inventory
Net Investment	Designated as offsetting the FX risk of the equity of a foreign operation	✓ Currency swap ✓ Currency forward

7.3.1.2. Investor Use Derivatives to

➢ Replicate a cash market strategy:

■ greater liquidity and reduced capital required to trade derivatives.

➢ Hedge a fund's value against adverse movements in underlying:

■ derivative hedges enable investors to isolate certain underlying exposures in the investment process while retaining a position in others.

➢ Modify or add exposures using derivatives, which in some cases are unavailable in cash markets:

■ the flexibility to take short positions or to increase or otherwise modify exposure using derivatives beyond cash alternatives.

7.3.2. 基础题

Q-7. Which of the following statement is most likely correct according to hedge designation:

A. A cash flow hedge is a derivative used to offset the fluctuation in fair value of an asset or liability.

B. A fair value hedge is a derivative designated as absorbing the variable cash flow of a floating-rate asset or liability.

C. A net investment hedge is a derivative designated as offsetting the foreign exchange risk of the equity of a foreign operation.

Q-8. Which of the following statement about the derivative market participants is most likely correct?

A. Investors use derivatives to offset or hedge market-based underlying exposures incidental to their commercial operations and financing activities.

B. Issuers use derivatives to replicate a cash market strategy, hedge a fund's value against

adverse movements in underlyings, or modify or add exposures using derivatives.

C. Both issuers and investors use derivatives to change their exposure to an underlying asset price without transacting in the cash market.

Q-9. Regarding to the descriptions of derivative market risks below, which one does not match?

A. Basis risk is that the expected value of a derivative differs unexpectedly from that of the underlying.

B. Unsystematic risk is the risk that excessive risk taking and use of leverage in derivative markets contribute to market stress.

C. Liquidity risk appears when a divergence in the cash flow timing of a derivative versus that of an underlying transaction.

7.4. Forward Contract

7.4.1. 重要知识点

7.4.1.1. Classification of forward contract
  ➤ Commodity forward contract
  ➤ Financial forward contract

7.4.1.2. Characteristics forward contract
  ➤ Each party are exposed to default risk (or counterparty risk)
  ➤ Zero-sum game

7.4.1.3. Forward contract pricing
  ➤ Forward price = price that would not permit profitable riskless arbitrage in frictionless markets
  ➤ $FP = S_0 \times (1+R_f)^T +$ Carrying Costs - Carrying Benefits

7.4.2. 基础题

Q-10. Two counterparties sign a forward contract on a stock, the underlying stock price goes up afterward, who will most likely suffer from credit default risk?

A. The long position only.

B. The short position only.

C. Both long and short position.

Q-11. The price of a forward contract most likely:

A. decrease as the real interest rate increase.

B. increase as the price of the underlying goes up.

C. constant and set as part of the contract specifications.

Q-12. There are two forward contracts, contract 1 and contract 2, on the same underlying. The underlying makes no cash payments, does not have any nonfinancial benefits and storage costs. Contract 1 expires in one and half year, contract 2 expires in six months. It is most likely that the price of contract 1:

A. is equal to the price of contract 2.

B. is less than the price of contract 2.

C. exceeds the price of contract 2.

Q-13. Identify which of the following activities corresponds to short forward replication?

A. Purchase an asset at today's spot price (S_0), and simultaneously enter into a forward commitment to sell the asset at the forward price, $F_0(T)$.

B. Sell the asset short for S_0 at t = 0, and lend proceeds of the asset sale at the risk-free rate, r. At time t = T, buy back the asset at the spot price, S_T.

C. Borrow at the risk-free rate, r, and buy the underlying asset at today's spot price (S_0). At time T, sell the asset at the spot price (S_T). Repay the loan principal and interest $S_0(1 + r)^T$ at time T.

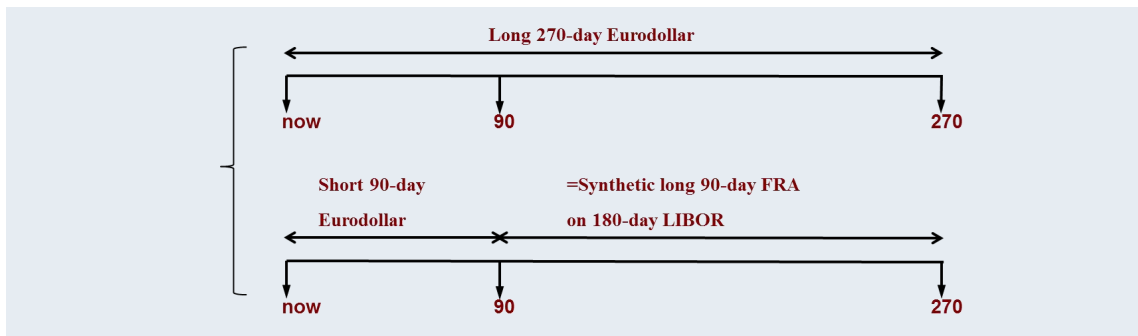### 7.5. Forward Rate Agreements(FRA)

7.5.1. 重要知识点

7.5.1.1. 概念

> **Definition:** viewed as a forward contract for the long to get a loan from the short at a specific future date at a fixed rate in the contract.

> A forward rate agreement (FRA) is a forward contract on an interest rate (market reference rate, MRR).

> **Quotation:** A 60-day FRA on 90-day MRR（2×5 FRA）means: Settlement or expiration is 60 days from now and the payment at settlement is based on 90-day MRR 60 days from now.

7.5.1.2. Settlement

> Settle in cash, but no actual loan is made at the settlement date.

> Payoff

■ If the reference rate at the expiration date is above the specified contract rate, the long will receive cash payment from the short;

■ If the reference rate at the expiration date is below the contract rate, the short will receive cash payment from the long

7.5.1.3. Synthetic FRA:

7.5.2. 基础题

Q-14. A synthetic long position in a 60-day forward rate agreement (FRA) in which the underlying is 180-day MRR can be created by taking a:

A. long position in a 60-day Eurodollar time deposit and a short position in a 180-day Eurodollar time deposit.

B. long position in a 60-day Eurodollar time deposit and a short position in a 240-day Eurodollar time deposit.

C. long position in a 240-day Eurodollar time deposit and a short position in a 60-day Eurodollar time deposit.

Q-15. An investor who holds a long position in a Forward Rate Agreement (FRA):

A. receives an unknown interest payment.

B. makes an unknown interest payment.

C. receives a known interest payment.

Q-16. Abu Rock, CFA, works for Titan Investments, PLC, a Shanghai-based real estate investment company. Abu entered into an FRA contract by locking the borrowing rate at 4.5%, what would happen to his position if interest rate increases to 5.5% at the end of contract expiration:

A. The FRA would meet a loss, but Abu can choose not to realized it.

B. Abu's positions can make a favorable gain.

C. Abu has to take the loss from his FRA position.

7.6. Futures Contract

7.6.1. 重要知识点

7.6.1.1. Futures contract 风险控制方法

➢ **Margin**

■ Initial margin: the first deposit is called the initial margin. Initial margin must be posted before any trading takes place;

- **Maintenance margin:** is the amount of money that each participant must maintain in the account after the trade is initiated. If the margin balance is **lower than the maintenance margin**, the trader will get a <u>margin call</u>;

- **Variation margin:** used to bring the margin balance back up to the initial margin level.

- **Daily price limit:** price limits are exchanged-imposed limits on how much the contract price can change from the previous day's settlement price.

- **Marking to market:** the margin requirement of a futures contract is low because at the end of every day there is a daily settlement process called marking to market.

- **Difference between forward and futures**

Forwards	Futures
Private contracts	Exchange-traded
Unique customized contracts	Standardized contracts
Little or no regulation	Regulated
Default risk is present	Guaranteed by clearinghouse
Settlement at maturity	Daily settlement(mark to market)
No margin deposit required	Margin required and adjusted

7.6.1.2. 掌握股票与期货保证金的区别：

	期货 margin	股票 margin
目的	作抵押减少违约风险	借钱给你买股票，举杠杆
现金流方向	现金流出	现金流入
支付利息	不用支付利息	相当于贷款给你，要付利息
补交 margin 数额	回到 initial margin	回到 maintenance margin

- **Clearinghouse**

  - Each exchange has a clearing house which is a third participant guaranteeing to each party that it ensures against the other party defaulting.

  - A clearinghouse acts as the counterparty to each participant. The clearinghouse is the buyer to the seller and the seller to the buyer by crediting gains to the winners and charging losses to the losers.

  - There is no need to worry about the counterparty default risk.

  - Each participant are allowed by the clearinghouse to reverse their positions in the future.

7.6.2. 基础题

Q-17. Tony Harris is planning to start trading in commodities. He has heard about the use of futures contracts on commodities and is learning more about them. Which of the

following is Harris least likely to find associated with a futures contract?

A. Existence of counterparty risk.

B. Standardized contractual terms.

C. Payment of an initial margin to enter into a contract.

Q-18. When receive a margin call, an investor must deposit more money to meet the in the futures market, whereas to meet the in the stock market:

A.   Initial margin   Initial margin

B.   Maintenance margin   Maintenance margin

C.   Initial margin   Maintenance margin

Q-19. In futures markets, contract performance is most likely guaranteed by:

A. clearing houses.

B. futures exchanges.

C. regulatory agencies

7.7. Swap Contract

7.7.1. 重要知识点

7.7.1.1. 定义

- ➢ **Swap contract:** A swap contract obligates two parties to exchange a series of cash flows on periodic settlement dates over a certain time period
- ➢ Three kinds of swaps
  - ■ Interest rate swaps
    - ◆ Interest rate swap in which one party pays a fixed rate and the other pays a floating rate.
  - ■ Currency swaps
    - ◆ 双方互换不同国家货币
    - ◆ Notional principle will be changed in a currency swap.
  - ■ Equity swaps
    - ◆ Permit investors to pay the return on one stock index and receive the return on another index or a fixed rate.

7.7.1.2. 与 forward 相似点

- ➢ No payment required by either party at initiation except the principal values exchanged in currency swaps.
- ➢ Custom instruments.
- ➢ Not traded in any organized secondary market.

> ➤ Largely unregulated.

> ➤ Default risk is a critical aspect of the contracts.

> ➤ Institutions dominate.

7.7.1.3. Plain vanilla interest rate swap: involves trading fixed interest rate payments for floating-rate payment (paying fixed and receiving floating).

> ➤ **Counterparties:** The parties involved in any swap agreement are called the counterparties

> ➤ **Pay-fixed side:** The counterparty that makes fixed-rate interest payment in exchange for variable interest rate**.**

> ➤ **Pay-floating side:** The counterparty that makes variable-rate interest payment in exchange for fixed payment.

7.7.2. 基础题

Q-20. In a currency swap, the underlying principal amount is exchanged:

A. only at the start of the swap.

B. only at the end of the swap.

C. both at the start and at the end of the swap.

Q-21. Identify which of the following characteristics does not match with certain forward commitment contract:

A. An interest rate swap involves periodic settlements based on the difference between a constant fixed rate and the MRR.

B. A series of forward rate agreements (FRAs) involves a single settlement based on the difference between a fixed rate established for each period and the MRR.

C. Both interest rate swap and a series of FRAs have a symmetric payoff and a value of zero to both counter-parities at inception.

7.8. Basic Concept of Options

7.8.1. 重要知识点

7.8.1.1. Basic characteristics of options (4 positions of options)

> ➤ Definition of option

> > ■ A derivative contract in which one party, the buyer, pays a sum of money to the other party, the seller or writer, and receives the right to either buy or sell an underlying asset at a fixed price either on a specific expiration date or at any time prior to the expiration date.
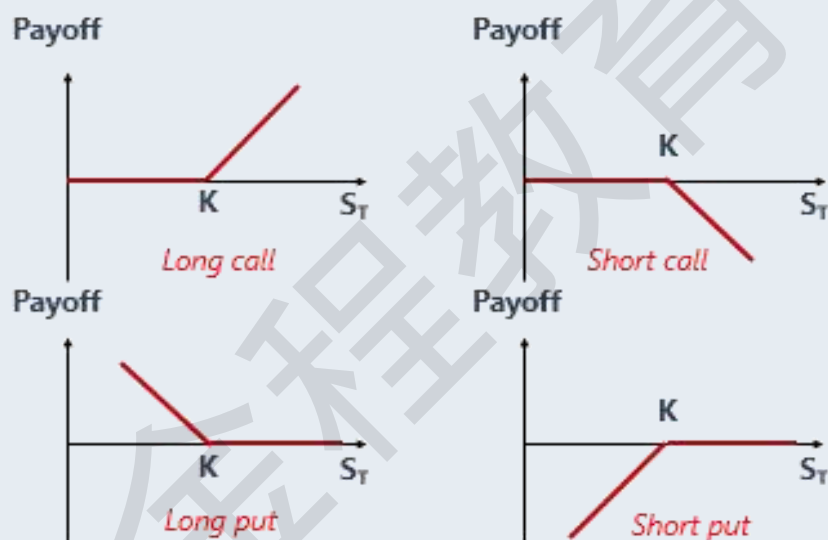
> ➤ 分类

- ■ Call option 看涨期权：long call and short call
- ■ Put option 看跌期权：long put and short put
- ➢ 价格
  - ■ 期权费 option premium: paid by the buyer of option
  - ■ 行权价格 exercise price: represent the exercise price specified in the contract.
- ➢ An option to buy an asset at a particular price is termed a call option

Buyer of a call	Right to buy	
Seller of a call		Obligation to sell

- ➢ An option to sell an asset at a particular price is termed a put option

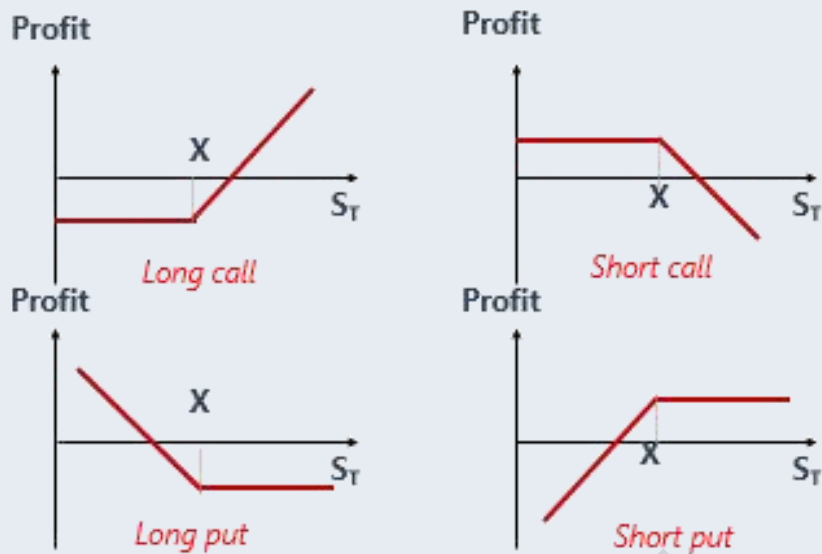| Buyer of a put	Right to sell	
Seller of a put		Obligation to buy

- ➢ Payoff

- ➢ **Payoff for options**
  - ■ Long call: $c_T = Max(0, S_T - X)$
  - ■ Short call: $c_T = - Max(0, S_T - X)$
  - ■ Long put: $p_T = Max(0, X - S_T)$
  - ■ Short put: $p_T = - Max(0, X - S_T)$
- ➢ Gain or loss

> **Profits for options**
> ■ Long call: $c_T = Max(0, S_T - X) - c_0$
> ■ Short call: $c_T = - Max(0, S_T - X) + c_0$
> ■ Long put: $p_T = Max(0, X - S_T) - p_0$
> ■ Short put: $p_T = - Max(0, X - S_T) + p_0$

7.8.2. 基础题

Q-22. Which of the following option positions involves unlimited potential loss?

A. Short call

B. Short put

C. Long put

Q-23. Which of the following parties to an option contract is capable of default?

A. Both the option seller and the option buyer.

B. The option seller only.

C. The option buyer only.

Q-24. An investor writes a put option with an exercise price of $50 for $5. At expiration, the investor incurs a loss of $24. What is the stock price at expiration?

A. $21

B. $26

C. $29

7.9. Risk Neutrality

7.9.1. 重要知识点

7.9.1.1. **Risk-neutral investors** are willing to buy risky investments for which they expect to earn only the risk-free rate. They do not expect to earn a premium for bearing risk.

7.9.1.2. **The expected payoff of the derivative can be discounted at the risk-free rate.** And should yield <u>the risk-free rate of return</u>, if it generates certain payoffs.

7.9.2. 基础题

Q-25. Derivatives pricing models use the risk-free rate to discount future cash flows because these models:

A. are based on portfolios with uncertain payoffs.

B. assume that derivatives investors are risk-neutral.

C. assume that risk can be eliminated by diversification.

Q-26. A perfectly hedged position consisting of a derivative and its underlying asset will most likely yield a return that is:

A. greater than the risk-free rate.

B. smaller than the risk-free rate.

C. equal to the risk-free rate.

Q-27. An investor constructs a risk-free portfolio by going long on a stock and short on an option. What is this strategy called?

A. Replication

B. Arbitrage

C. Fiduciary Call

7.10. Moneyness, Intrinsic Value, Time Value

7.10.1. 重要知识点

7.10.1.1. Option 的主要种类

> - Financial option
>   - Equity options
>   - Interest options
>   - Foreign currency options
>   - Bond options
>   - Index options
> - Commodity option

7.10.1.2. Moneyness（价值状态）：**定性看 long 是否赚钱**

> ➢ **In the money:** immediate exercise would generate a **positive payoff.**

> ➢ **At the money**: immediate exercise would generate no payoff.

> ➢ **Out of the money:** immediate exercise would generate a **negative payoff.**

Moneyness	Call option	Put option
In-the-money	S > X	S < X
At-the-money	S = X	S = X
Out-of-the-money	S < X	S > X

7.10.1.3. Intrinsic Value and Time Value

> ➢ The **intrinsic value** or **exercise value** of an option is the amount that it is in the money, and zero otherwise.
>
> > ■ Intrinsic value of call option: $C = max[0, S-X]$
> >
> > ■ Intrinsic value of put option: $P = max[0, X-S]$

> ➢ **Time value**
>
> > ■ The difference between the price of an option (called its premium) and its intrinsic value is due to its time value.
> >
> > ■ European put option: time value can be larger than, smaller than or equal to zero.
> >
> > ■ For others, time value is not less than zero.

> ➢ **Option value = intrinsic value + time value**
>
> > ■ Before expiration: option value>intrinsic value
> >
> > ■ At expiration: option value=intrinsic value

7.10.1.4. Replication

> ➢ Long call + short put=long forward/long asset

7.10.2. 基础题

Q-28.   At expiration, an option that is in the money will most likely have:

A.   time value, but no exercise value.

B.   exercise value, but no time value.

C.   both time value and exercise value.

Q-29.   What is the upper limit for the value of a European call option? The maximum value is equivalent to the:

A.   strike price.

B.   current price of the underlying asset.

C.   present value of the strike price.

Q-30.   Which of the following statements most closely relates to the concept of moneyness?

A. The sum of money the option buyer pays the seller is called the premium.

B. Both call and put option prices decline as the time to expiration becomes shorter.

C. One would never exercise a call option if the price of the underlying is below the strike price.

Q-31. The recent price per share of Hua Big, Inc. is €80 per share. Selina Woods buys 150 shares at €80. To protect against a falling price, Woods buys one put, covering 150 shares of Hua Big, with a strike price of €70. The put premium is €1.5 per share. If Hua Big closes at €76 per share at the expiration of the put and Woods sells her shares at €76, Woods' profit from the stay/put is closest to:

A. - €825.

B. - €600.

C. €375.

7.11. Option Sensitivity

7.11.1. 重要知识点

7.11.1.1. 影响 option 价格的因素：

Factor	European call	European put	American call	American put
Underlying asset price	+	-	+	-
Strike price	-	+	-	+
Time	+	*	+	+
Risk-free rate	+	-	+	-
Volatility	+	+	+	+
Payments on the underlying	-	+	-	+
Carrying cost	+	-	+	-

*There is an exception to the general rule that European put option thetas are negative. The put value may increases as the option approaches maturity if the option is deep in-the-money and close to maturity. The higher the risk-free rate, the stronger the negative relationship.

7.11.2. 基础题

Q-32. Which statement best describes the early exercise of non-dividend paying American options? Early exercise may be advantageous for:

A. deep-in-the-money calls.

B. both deep-in-the-money calls and deep-in-the-money puts.

C. deep-in-the-money puts.

Q-33. If there are two call options for two different underlying assets, and related information is shown in the table below.

	Option 1	Option 2
Payments on the underlying	Positive	Zero
Carrying cost	Zero	Positive

Based on the table, which of the option is most likely to have higher value?

A. Option 1

B. Option 2

C. The same

Q-34. The value of a call option can be positively correlated to the:

A. exercise price & risk-free rate

B. risk-free rate & volatility

C. exercise price & volatility

7.12. Put-Call Parity

7.12.1. 重要知识点

7.12.1.1. Put-call parity

➢ **Put call parity:** consists two portfolio: <u>fiduciary call</u> and <u>protective put</u>.

■ $c_0 + X/(1+R_f)^T = S_0 + p_0$

◆ <u>fiduciary call</u>: $c_0 + X/(1+R_f)^T$

◆ <u>protective put</u>: $S_0 + p_0$

➢ **Put-call parity 的作用**

■ Pricing

■ Positions replicating

■ Risk free arbitrary

◆ 遵循低买高卖，E.g., $C + \dfrac{X}{(1+RFR)^T} > S + P$ 套利方法是：（long 小边）long security, long put,（short 大边）short call, short bonds.

➢ **Replication (熟练掌握 put-call parity 公式的各种变形):**

- $S = C - P + X / (1 + RFR)^T$

- $P = C - S + X / (1 + RFR)^T$

- $C = S + P - X / (1 + RFR)^T$

- $X / (1 + RFR)^T = S + P - C$

  - ◆ Note that the options much be European-style and the puts and calls mush have the same exercise price for these relations to hold.
  - ◆ Fiduciary call: buy riskless bond that pays X at maturity and a call with exercise price X.
  - ◆ Protective put: buy security and long put.
- ➢ Put-call-forward parity can be written as
  - ■ p-c=[X-F (T)]/(1+r)^T
  - ■ This means that the difference between the price of a put and the price of a call is equal to the difference between exercise price and forward price discounted at the risk-free rate.

7.12.2. 基础题

Q-35. A description that will least likely be used to explain put-call parity is:

A. The exercise prices of calls and puts on an underlying asset must be consistent with each other to remove arbitrage opportunities.

B. A fiduciary call option strategy and a protective put option strategy for an underlying asset are equal in value.

C. A put is equivalent to long a call, a long position in the underlying asset, and a long position in the risk-free asset.

Q-36. A stock is selling at $40, a 3-month put at $50 is selling for $11, a 3-month call at $50 is selling for $1, and the risk-free rate is 6%. How much, if anything, can be made on an arbitrage?

A. $0 (no arbitrage)

B. $0.28

C. $0.72

Q-37. According to put–call–forward parity, the difference between the price of a put and the price of a call is most likely equal to the difference between:

A. forward price and spot price discounted at the risk-free rate.

B. spot price and exercise price discounted at the risk-free rate.

C. exercise price and forward price discounted at the risk-free rate.

Q-38. Which of the following most accurately characterizes a protective put strategy? In this strategy, an investor holds a:

A. Long position in the underlying asset along with a short position in a put option on the same asset.

B. Long position in the underlying asset along with a long position in a put option on the same asset.

C. Short position in the underlying asset along with a long position in a put option on the same asset.

Q-39. According to put-call parity, a synthetic call option is equivalent to a position that is:

A. long a call and long a risk-free bond.

B. long a put, long the underlying asset, and short a risk-free bond.

C. short a put, short the underlying asset, and long a risk-free bond.

7.13. Option Put–Call Parity Applications: Firm Value

7.13.1. 重要知识点

7.13.1.1. Option Put–Call Parity Applications: Firm Value

- $V_0 = E_0 + PV(D)$.
  - V_0: market value of firm; E_0: equity value; $PV(D)$: present value of zero-coupon debt.
- **When the debt matures at T, depending on the firm's value (V_T):**
- **Solvency:** If $V_T > D$, the firm is *solvent* and able to return capital to *both* its shareholders and debtholders.
  - Debtholders receive D and are repaid in full.
  - Shareholders receive the residual: $E_T = V_T - D$.
- **Insolvency**: If $V_T < D$, the firm is insolvent. In the event of insolvency, shareholders receive nothing, and debtholders are owed more than the value of the firm's assets. Debtholders therefore receive V_T to settle their debt claim of D at time T.
  - Debtholders have a priority claim on assets and receive $V_T < D$.
  - Shareholders receive the residual, $E_T = 0$.
- Firm value distribution between shareholders and debtholders.
  - Shareholder payoff = $\max(0, V_T - D)$
  - Debtholder payoff = $\min(V_T, D)$

7.13.2. 基础题

Q-40. Based on put-call parity application, the firm value is least likely be described as:

A. If the value of the firm (V_T) is below the face value of its debt outstanding, debtholders will receive less than the face value (D) to settle their debt claim.

B. A debtholder's payoff is min(D, V_T) and equals the debt face value (D) minus a put option on firm value (V_T) with an exercise price of D.

C. A debtholder's position may be considered similar to the long put option on firm value.

7.14. Arbitrage and No-Arbitrage Principle

7.14.1. 重要知识点

7.14.1.1. Risk-free arbitrage and no-arbitrage rule

➢ **Arbitrage** involves earning over the risk-free rate with no risk or earning an immediate gain with no future liabilities.

■ Arbitrage opportunities: arbitrage occurs when equivalent assets or combinations of assets sell for two different prices.

➢ **Law of one price:** the condition in a financial market in which two equivalent financial instruments or combinations of financial instruments can sell for only one price. Equivalent to the principle that no arbitrage opportunities are possible.

➢ The role of arbitrage is to eliminate mispricing and lead to the market efficiency. That is why arbitrage also plays a role in pricing.

➢ **Hedge portfolio**: Derivatives usually take their values from the underlying by constructing a hypothetical combination of the derivatives and the underlyings that eliminates risk. This combination is typically called a **hedge portfolio**. With the risk eliminated, it follows that the hedge portfolio should earn the **risk-free rate**.

7.14.2. 基础题

Q-41. Which of the following statements relating to derivatives pricing is most accurate?

A. Investors are assumed to be rational and risk averse.

B. Expected payoffs are discounted at the risk-free rate.

C. Markets are assumed to offer arbitrage opportunities.

Q-42. An analyst observes a current USD/GBP spot exchange rate of 1.22, a US risk-free rate of -0.25%, and a UK risk-free rate of 1.5%. Which of the following statements describe the action that can take today to earn a riskless profit if the one-year USD/GBP forward rate is observed to be 1.205?

A. No arbitrage opportunity exists, because the observed one-year USD/GBP FX forward rate equals the no-arbitrage rate capturing the net effect of the domestic versus foreign risk-free rate for one year.

B. Since the no-arbitrage one-year USD/GBP forward rate is 1.196, the investor should borrow in US dollars and buy British pounds today, simultaneously selling British pounds against US dollars one year forward.

C. Since the no-arbitrage one-year USD/GBP forward rate is 1.196, the investor should borrow in British pounds and buy US dollars today, simultaneously buying British pounds and selling US dollars one year forward.

7.15. Forward Pricing and Valuation

7.15.1. 重要知识点

7.15.1.1. Forward pricing and valuation

➢ Pricing a forward contract is the process of determining the no-arbitrage price that will make the value of the contract be zero to both sides at the initiation of the contract

■ General Equation: $FP=(S_0-PVB_0+PVC_0) \times (1+R_f)^T$

◆ Monetary benefits: dividends, coupons, interest, etc.

◆ Non-monetary benefits: convenience yield.

◆ **Convenience yield** are primarily associated with commodities and generally exist as a result of difficulty in either shorting the commodity or unusually tight supplies.

◆ The net cost and benefit is often referred to by the term **carry**, or sometimes **cost of carry**. (Benefit-cost)

➢ Valuation of a forward contract means determining the value of the contract to the long (or the short) at some time during the life of the contract.

Time	Forward Contract Valuation
t=0	Zero, because the contract is priced to prevent arbitrage
t=t	$V_{long} = S_t - \dfrac{FP}{\left(1+R_f\right)^{T-t}}$ $\quad$ $V_{short} = -V_{long} = \dfrac{FP}{\left(1+R_f\right)^{T-t}} - S_t$
t=T	$S_T - FP$

➢ T-bill (zero-coupon bond) forwards

■ $FP=S_0 \times (1+R_f)^T$

➢ Forward contracts on a dividend-paying stock

■ $FP=(S_0-PVD_0) \times (1+R_f)^T$

$$V_{long}=(S_t-PVD_t) - FP/(1+R_f)^{T-t}$$

7.15.2. 基础题

Q-43. Consider a three-month commodity forward contract, the underlying asset is selling for $40 in which the present value of carrying benefit and carrying cost are $5 and $3, respectively. If the risk free rate is 4%, the forward price is closest to:

A. 41.60

B. 39.52

C. 38.38

Q-44. Over time, a forward contract most likely has variable:

A. value and constant price.

B. price and constant value.

C. value and variable price.

Q-45. Procam Investments wants to purchase a 100-ounce gold three months later. The current spot price is $100 per gold contract (100 ounce), the risk-free rate is 2.0%. We assume, during next three months, gold may be stored at a bank with a current cost of $2.5 per 100-ounce and produce a current benefit of $3.5 per 100-ounce. Calculate the no arbitrage forward price, $F_0(T)$, for settlement in 90 days (T = 90/360 or 0.25):

A. $101.50.

B. $99.49

C. $100.

Q-46. Stocks BWQ and ZER are each currently priced at $100 per share. Over the next year, stock BWQ is expected to generate significant benefits whereas stock ZER is not expected to generate any benefits. There are no carrying costs associated with holding either stock over the next year. Compared with ZER, the one-year forward price of BWQ is most likely:

A. lower.

B. the same.

C. higher.

Q-47. Assume that at Time 0 an investor entered into a forward contract to sell a stock at a price of $F_0(1) = \$32$ one year from now. Three month later, at Time t= 0.25, the forward price of the underlying stock is $F_{0.25}(1) = \$27.5$ and the risk-free rate is 4%. The value of the existing forward contract expiring in nine months will be closest to:

A.   -4.3696

B.   4.3269

C.   4.3696

Q-48. A high convenience yield is most likely associated with holding:

A.   commodities.

B.   equities.

C.   bonds.

7.16. Futures Pricing and Valuation

7.16.1. 重要知识点

7.16.1.1. Futures pricing and valuation: futures price and forward price

If the correlation between the underlying asset value and interest rate is…	Investors will…
Positive	Prefer to go long in a futures contract, and the futures price will be greater than the price of an otherwise comparable forward contract.
Zero	Have no preference
Negative	Prefer to go long in a forward contract, and the forward price will be greater than the price of an otherwise comparable futures contract.

7.16.2. 基础题

Q-49. Which of the following statements is least accurate concerning differences in the pricing of forwards and futures?

A.   Interest rate volatility can explain pricing differences.

B.   Pricing differences can arise if futures prices and interest rates are uncorrelated.

C.   Differences in the pattern of cash flows of forwards and futures can explain pricing differences.

Q-50. If futures prices are negatively correlated with interest rates, then futures prices are likely to be:

A. higher than forward prices.

B. lower than forward prices.

C. equal to forward prices.

7.17. Swap Pricing and Valuation

7.17.1. 重要知识点

7.17.1.1. Swap pricing and valuation

➤ **Equivalence of swaps to bonds:** An interest rate swap is identical to issuing a fixed-rate bond and using the proceeds to buy a floating-rate bond.

➤ **Equivalence of swaps to forward contracts (FRA):** A forward contract is an agreement to exchange future cash flows once, so a swap can be viewed as a series of forward contracts.

7.17.2. 基础题

Q-51. Which of the following statements about the value of a swap is correct?

A. The value usually changes throughout the duration of the contract.

B. The value remains constant and equal to the initial price throughout the contract.

C. The value is always set by exchange trading.

Q-52. Identify which of the following statements is associated with fixed-rate receiver in an interest rate swap contract?

A. Realizes an MTM gain on a swap contract if the expected future floating-rate payments increase.

B. An investor may increase portfolio duration by entering this position in a swap contract.

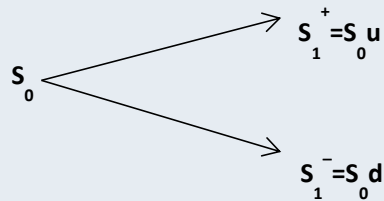C. Establishes a set of certain net future cash flows on a swap contract at inception.

7.18. Option Pricing and Valuation

7.18.1. 重要知识点

7.18.1.1. Option pricing and valuation

➤ **Binomial model**

■ A binomial model is for pricing options in which the underlying price can move to only one of two possible new prices.

■ We start off by having only one binomial period, which means that the

underlying price moves to two new prices at option expiration. We let S_0 be the price of the underlying stock now. One period later, the stock price can move up to S_1^+ or down to S_1^-. We then identify a factor, u, as the up move on the stock and d as the down move. Thus, $S_1^+ = S_0 u$ and $S_1^- = S_0 d$. <u>We further assume that u = 1/d.</u>

$$S_0 \nearrow \begin{array}{l} S_1^+ = S_0 u \\[1em] S_1^- = S_0 d \end{array}$$

- Risk-neutral probability of an up move is π_u ; Risk-neutral probability of an down move is π_d

  ◆ $$\pi_u = \frac{1 + R_f - d}{u - d}$$

  ◆ $\pi_d = 1 - \pi_u$

- We should notice that:

  ◆ On the first point, if volatility increases, the difference between S_1^+ and S_1^- increases, which widens the range between c_1^+ and c_1^-, leading to a higher option value. The upper payoff, c_1^+, will be larger and the lower payoff, c_1^-, will be lower.

  ◆ On the second point, the actual probabilities of the up and down moves do not matter. This result is because of our ability to construct a hedge and the rule of arbitrage.

- On the third point, the irrelevance of the actual probabilities is replaced by the relevance of a set of synthetic or pseudo probabilities, π and $1-\pi$, which are called risk-neutral probabilities.

7.18.1.2. Early Exercise of American Options

➢ **American call options**

- When the underlying makes no cash payments (dividends and coupon interest), no reason to exercise the call early, $C_0 = c_0$.

- When the underlying makes cash payments (dividends and coupon interest) during the life of the option, early exercise can happen, $C_0 >= c_0$.

➢ **American put options**

- $P_0 > p_0$, nearly always true, as long as there is a possibility of bankruptcy, P_0 always $> p_0$, (consider an American put on a bankrupt company, stock $\to 0$, cannot go any lower, then put option holder may exercise it).

7.18.2. 基础题

Q-53. The most correct statement about the binomial option pricing formula is that:

A. The discount rate to calculate the option price is the risk-free rate.

B. The discount rate to calculate the option price is the risk-free rate plus a risk premium

C. The spot price is compounded at the risk-free rate to get the expected payoff

Q-54. If a one-period binomial model is used to price an at-the-money call option, which of the following statements is most accurate? The option will be:

A. in-the money if the price moves up.

B. at-the-money if the price moves up or down.

C. out-of-the-money if the price moves up.

Q-55. Which of the following factors influences the value of an option price when using a binomial model?

A. The level of investors' risk aversion.

B. The risk-free rate of return.

C. The probability of an upward and downward price move.

Q-56. If the implied volatility for options on a broad-based equity market index goes up, then it is most likely that:

A. The broad-based equity market index has gone up in value.

B. Market interest rates have gone up.

C. The general level of market uncertainty has gone up.

Q-57. A 1-year put option on the stock with the strike price of $32, and the price of the stock is $32 now, and the size of an up-move is 1.1. The risk-free rate is 6%. The value of the put option is closest to:

A. 0.30.

B. 0.60.

C. 1.20.

Q-58. A stock's price is currently trade at ¥7,950. At the end of one month when its options expire, the stock price is either up by 12% or down by 8%. If the risk-free rate is -0.5% for the period, what is the value of a call option with a strike price of ¥7,880:

A. ¥386.

B. ¥279.

C.　¥341.

Solutions

7. Derivatives

Q-1. Solution: A.

A futures contract is classified as a forward commitment in which the buyer undertakes to purchase the underlying asset from the seller at a later date and at a price agreed on by the two parties when the contract is initiated.

A call option contract is a contingent claim in which the buyer of the option has a right to purchase the underlying asset at a fixed price on or before a pre-specified expiration date.

A credit default swap is a contingent claim in which the credit protection seller provides protection to the credit protection buyer against the credit risk of a third party.

Q-2. Solution: A.

Over-the-counter options are exposed to default risk, but futures contracts are standardized transactions that take place on futures exchanges and are not exposed to default risk.

Q-3. Solution: A.

Although an exchange-traded fund derives its value from the underlying assets it holds, it does not transform the performance of those assets and so is not a derivative.

A contract to sell Alphabet Inc.'s shares transforms the performance of the underlying shares of Alphabet Inc and is an example of an option derivative.

A contract to buy Australian dollars transforms the performance of the underlying currency and is an example of a currency derivative.

Q-4. Solution: B.

ETD refers to exchange-traded derivative markets, it includes futures, options, and other financial contracts available on exchanges. ETD contracts are more formal and standardized, which facilitates a more liquid and transparent market. Terms and conditions—such as the size of each contract, type, quality, and location of underlying for commodities and maturity date—are set by the exchange.

OTC refers to over-the-counter derivative market, OTC contracts can be customized to match a desired risk exposure profile, which have greater privacy.

Both ETD and OTC markets use market makers. Exchange memberships are held by market makers (or dealers) that stand ready to buy at one price and sell at a higher price. In OTC market, the OTC dealers, known as market makers, typically enter into offsetting bilateral transactions with one another to transfer risk to other parties.

Q-5. Solution: A.

Derivative markets are not by nature more or less volatile than spot markets.

They facilitate risk allocation by making it easier and less costly to transfer risk, and their transaction costs are lower than those of spot markets.

Q-6.   Solution: A.

Derivatives allow investors to allocate, transfer, and manage risk efficiently, often without directly trading the underlying asset. For instance, derivatives enable an issuer to hedge future debt costs or provide portfolio managers the flexibility to modify their exposure to different market conditions, making them powerful tools for effective risk management.

Derivatives actually make short-selling easier, not more difficult. Through instruments like options and futures, investors can take short positions without directly borrowing or selling the underlying asset, making it easier and less costly to bet against or hedge against an asset's price decline.

While derivatives can enhance returns and offer strategies to manage risk, they do not guarantee long-term excess returns. Derivatives are tools that help manage exposure and hedge risk, but achieving consistent excess returns depends on market conditions and the investor's strategy, which inherently involves risk.

Q-7.   Solution: C.

A fair value hedge is a derivative used to offset the fluctuation in fair value of an asset or liability.

A cash flow hedge is a derivative designated as absorbing the variable cash flow of a floating-rate asset or liability.

Q-8.   Solution: C.

Issuers predominantly use derivatives to offset or hedge market-based underlying exposures incidental to their commercial operations and financing activities.

In contrast, investors use derivatives to replicate a cash market strategy, hedge a fund's value against adverse movements in underlyings, or modify or add exposures using derivatives, which in some cases are unavailable in cash markets.

Q-9.   Solution: B.

Systemic risk involves excessive risk taking and use of leverage in derivative markets that contribute to market stress, not the unsystematic risk.

Q-10.   Solution: A.

The long position faces counterparty credit risk of short position when the underlying stock price goes up afterward and is higher than the forward price.

Q-11.   Solution: C.

The price of a forward contract remains constant throughout the life of the contract. It is set as part of the contract specifications.

Q-12.   Solution: C.

The forward price is the spot price compounded at the risk-free rate over the life of the contract. Because contract 1 has the longer life, compounding will lead to a higher value.

Q-13.   Solution: B.

The short sale of an asset at time t=0 creates a position that replicates a short forward, as the return is equal to $F_0(T)-S_T$ for both a short forward and the replication strategy.

Q-14.   Solution: B.

To create a synthetic long position in a 60-day FRA on the 180-day MRR, the investor needs to replicate the same exposure as being long the FRA, which means benefiting from rising interest rates. This can be done by constructing a position that is effectively net short on the 180-day Eurodollar because a short Eurodollar position gains when interest rates increase.

Long position in a 60-day Eurodollar time deposit: This reflects a view that rates will fall over the first 60 days, locking in interest rates for that period.

Short position in a 240-day Eurodollar time deposit: This position reflects a view that interest rates will rise over the entire 240-day period.

By combining these two positions, by subtracting the first 60 days (covered by the long position), the investor is left with a net short position on the remaining 180 days (i.e., from day 61 to day 240). This effectively replicates the exposure of a long FRA, as both the FRA and the net short Eurodollar position profit from rising interest rates after 60 days.

Q-15.   Solution: A.

An investor with a long position in an FRA, often referred to as a fixed-rate payer and floating-rate receiver, stands to benefit when market reference rates (MRR) increase. In this position, the investor agrees to pay interest based on a pre-agreed fixed rate, while receiving interest based on a variable market reference rate, determined at the time of settlement.

Q-16.   Solution: B.

Abu entered into an FRA contract by locking the borrowing rate at 4.5%, therefore he has long FRA position. Long party would meet a gain when the market interest rate (which is 5.5%) higher than FRA rate 4.5%.

FRA contract is a forward commitment, not an obligation, investor cannot choose whether to

realized the gain or loss.

Q-17.   Solution: A.

Harris is least likely to find counterparty risk associated with a futures contract. There is limited counterparty risk in a futures contract because the clearinghouse is on the other side of every contract.

Q-18.   Solution: C.

In stock market, additional margin must be deposited to bring the ending balance up to the maintenance margin requirement; However, in futures market, additional margin must be deposited to bring the ending balance up to the initial margin requirement.

Q-19.   Solution: A.

Clearing houses arrange for financial settlement of trades. In futures markets, they guarantee contract performance.

Q-20.   Solution: C.

In a currency swap, the underlying principal is denominated in different currencies and is typically exchanged at the start and end of the swap.

Q-21.   Solution: B.

A series of FRAs involves periodic settlements, not a single settlement based on the difference between a fixed rate established for each period and the MRR.

Q-22.   Solution: A.

The buyer of an option has the right, but not the obligation, to execute the trade, while the seller has the obligation to fulfill the transaction as decided by the buyer. In the case of a short call, the seller faces unlimited potential loss as the underlying asset price can appreciate infinitely. On the other hand, the short put party's loss is limited because the underlying price cannot fall below zero, and a long put provides the buyer with the right to sell at a specific price, limiting the buyer's potential loss to the premium paid.

Q-23.   Solution: B.

The option buyer has the right but not the obligation to transact the trade, and the option seller has the obligation to fulfill the transaction as chosen by the option buyer. Counterparty credit risk is the potential for a derivatives contract participant to fail to meet their obligations under an agreement. The option buyer and seller payoff profiles demonstrate the one-sided nature of

counterparty credit risk for contingent claims. That is, the option seller has no credit exposure to the option buyer once the premium is paid. However, the option buyer faces the counterparty credit risk of the option seller equal to the option payoff at maturity.

Q-24.   Solution: A.

A higher underlying price (S_T) will decrease the value of a put option. Since a put option is the right to sell an underlying, the put option settlement value of Max (0, $X - S_T$) will fall as S_T rises.

At maturity, the profit of the put option is:

Option premium=p_0=5

X=50

Profit=payoff + option premium = -Max(0, 50 - S_T) +5 = -24

S_T=21

Q-25.   Solution: B.

Derivatives pricing models use the risk-free rate to discount future cash flows (risk-neutral pricing) because they are based on constructing arbitrage relationships that are theoretically riskless.

These models are based on portfolios with certain payoffs (R_f).

Risk cannot eliminated by diversification.

Q-26.   Solution: C.

If a risk-free position earns a return that is different from the risk-free return, arbitrage will lead to the elimination of the mispricing.

Q-27.   Solution: A.

Replication is a strategy used to recreate the cash flow of a derivative by combining long or short positions in an underlying asset with borrowing or lending at the risk-free rate. In this case, the investor constructs a risk-free portfolio by going long on a stock and short on an option, which mirrors the payoff structure of a forward contract or a similar derivative. The aim is to replicate the cash flows rather than seek risk-free arbitrage profits.

Arbitrage, on the other hand, involves exploiting pricing inefficiencies to secure a risk-free profit, which is not the focus in this scenario. Therefore, replication is the appropriate strategy being described.

A fiduciary call involves holding a call option and enough risk-free assets (like bonds) to ensure that the investor can buy the underlying asset if the option is exercised.

Q-28.   Solution: B.

At expiration, options have no time value; if they are in the money, they have exercise value (also called intrinsic value).

Q-29.   Solution: B.

The maximum value of a European call option occurs when the call is deep in the money, meaning the option is almost certain to be exercised. In this scenario, the upper limit for the value of the call option would be the current price of the underlying asset, as this is the maximum potential payoff. This is because, at expiry, the call option allows the holder to buy the asset at the strike price, and the value of this right can't exceed the asset's current price.

Q-30.   Solution: C.

Only the in-the-money option would be exercised. Moneyness describes the relationship between the price of the underlying and an option's exercise price.

Q-31.   Solution: A.

The loss on her stock is (€76 - €80) X 150 = - €600. She also paid €1.5 X 150 = €225 for the put. The put expires worthless, making her total loss €825.

Q-32.   Solution: C.

Only deep-in-the-money put options may be exercised early. The price cannot fall below zero and thus the additional upside of such an option is limited.

Q-33.   Solution: B.

A call option's value is negatively correlated to the payments on the underlying, and positively related to the carrying cost, so the option 2 would have higher value.

Q-34.   Solution: B.

A call option's value is negatively correlated to the exercise price. The call option's value increases as the risk-free rate increases. And the volatility is positively related to both call and put options.

Q-35.   Solution: C.

For $P = C + X / (1+r_f)^T - S$

A put is equivalent to long a call, a short position in the underlying asset, and a long position in the risk free asset.

Q-36.   Solution: C.

A synthetic stock is $S = C - P + X / [(1+RFR)^T] = \$1 - \$11 + 50 / [(1.06)^{0.25}] = 39.28$. Since the stock is selling for \$40, you can short a share of stock for \$40 and buy the synthetic for an immediate arbitrage

profit of $0.72.

Q-37.   Solution: C.

Put-call-forward parity can be written as:

$P_0 - C_0 = [X - F_0(T)]/(1 + r)^T$

This means that the difference between the price of a put and the price of a call is equal to the difference between exercise price and forward price discounted at the risk-free rate.

Q-38.   Solution: B.

A protective put strategy is when an investor holds a long position in a security (or asset) while simultaneously holding a long position in a put option on the same security. This is done as a hedging strategy to protect against potential downside risk. If the price of the asset falls, the value of the put option increases, offsetting the loss on the asset. This approach ensures that the investor's losses are limited, while still allowing for upside potential if the price of the asset rises.

$c + X/(1 + R_f)^T = S + p$

fiduciary call: $c + X/(1 + R_f)^T$

protective put: $S + p$

Q-39.   Solution: B.

Put-call parity is a fundamental concept in options pricing that establishes a relationship between the price of a call option, put option, underlying asset, and a risk-free bond. The equation can be expressed as:

$$c + X/(1 + R_f)^T = S + p$$

Solving for the synthetic call is $c = S + p - \dfrac{X}{(1+R_f)^T}$

Therefore, the synthetic call is a combination of long a put, long the underlying asset, and short a risk-free bond.

Long a call and long a bond describes a fiduciary call, which is one side of the put-call parity equation. This strategy involves holding a call option and a bond with a face value equal to the strike price of the option.

Q-40.   Solution: C.

If the value of the firm (V_T) is below the face value of its debt outstanding, or $V_T < D$ at time T, we say the firm is insolvent and debtholders receive less than the face value (D) to settle their debt claim.

Stated differently, a debtholder's payoff is min(D, V_T) = D − max(0, D − V_T) and equals the debt face value (D) minus a put option on firm value (V_T) with an exercise price of D, which represents a sold put on firm value.

Q-41.   Solution: B.

In derivative pricing, the risk-neutral valuation method is commonly used. Under this approach, expected payoffs are calculated using risk-neutral probabilities rather than actual probabilities and are then discounted at the risk-free rate. This ensures that the pricing model aligns with the principle of no arbitrage, which assumes that there are no opportunities to make riskless profits through price discrepancies between markets.

Arbitrage-free pricing is a fundamental concept in derivatives markets. It ensures that the link between forward prices and spot prices prevents investors from taking advantage of any arbitrage opportunities. Hence, the market does not assume arbitrage possibilities, and derivative prices are structured accordingly.

Q-42.   Solution: A.

The spot versus forward relationship for a foreign exchange may be shown as follows:

$F_{0,f/d}(T) = S_{0,f/d}e^{(rf-rd)T}$

In the specific case of USD/GBP, the equation may be rewritten as

$F_{0,USD/GBP}(T) = S_{0,USD/GBP}e^{(rUSD-rGBP)T}$

If S_0 = 1.22, r_f = -0.25% and r_d = 1.5%, the no-arbitrage forward price in one year equals 1.205 (= $1.22e^{(-0.0025-0.015)}$) and no riskless profit opportunity exists.

Q-43.   Solution: C.

By using the formula: FP=(S_0-PVB_0+PVC_0) x $(1+Rf)^T$

Forward price=(40-5+3) x $(1+4\%)^{0.25}$=38.38

Q-44.   Solution: A.

The price of a forward contract remains constant throughout its life. It is set as part of the contract specifications. The value varies with changes in the price of the underlying.

Q-45.   Solution: B.

FP = F_0(T) = (100+2.5-3.5) x (1+2%)^0.25 = \$99.49

The no arbitrage forward price, F_0(T), for settlement in 90 days does not equal to current spot price with the consideration of the storage costs, benefits and

risk-free rate together.

Q-46.   Solution: A.

The forward price of each stock is found by compounding the spot price by the risk-free rate for the period and then subtracting the future value of any benefits and adding the future value of any costs. In the absence of any benefits or costs, the one-year forward prices of BWQ and ZER should be equal.

After subtracting the benefits related to BWQ, the one-year forward price of BWQ is lower than the one-year forward price of ZER.

Q-47.   Solution: C.

Note that, $F_0(1) = \$32$, $F_{0.25}(1) = \$27.5$, r = 4%, and T – t = 0.75.

We find that the value of the existing forward entered at Time 0 and valued at Time t is:

$V_t = PV[F_0(1) - F_{0.25}(1)] = (32-27.5) / (1+4\%)^{0.75} = 4.3696$.

Q-48.   Solution: A.

Convenience yield is primarily associated with commodities and generally exists as a result of difficulty in shorting the commodity or unusually tight supplies.

Q-49.   Solution: B.

Given the formula for the value of a forward contract, it follows that the value of the contract goes up as the price of the underlying goes up.

$$V_t(T) = S_t - F_0(T)(1 + r)^{-(T-t)}$$

Q-50.   Solution: B.

If futures prices are negatively correlated with interest rates, forward contracts are more desirable to holders of long positions than the futuers. Hence the price of the forward will be higher than the price of the futures.

A positive correlation between futures prices and interest rates leads to the opposite interpretation, with futuers being more desirable than forward to the long position. Since, in this example, interest rates are negatively correlated with equity futures, futures prices will be lower.

If futures prices and interest rates are uncorrelated, forwards and futures prices will be the same.

Q-51.   Solution: A.

The value of a swap fluctuates over the life of the contract as market conditions, interest rates, or other underlying factors change. At the initiation of the swap, its value is typically zero (or close to zero) since both parties agree on fair terms. However, as time progresses and market conditions shift, the value of the swap can move in favor of one party or the other.

Option B is incorrect because the price of the swap at initiation is agreed upon, but the value will

not remain constant throughout the contract.

Option C is incorrect as swaps are typically over-the-counter (OTC) contracts and are not traded on exchanges.

Q-52.   Solution: B.

A fixed-rate receiver may increase portfolio duration by entering this position on a swap, because receiving fixed is similar to a long bond position.

A fixed-rate payer realizes an MTM gain on a swap contract if the expected future floating-rate payments increase.

A swap contract establishes a set of certain fixed future cash flows that are exchanged for a set of expected (uncertain) floating future cash flows. Therefore, neither a fixed-rate payer nor a fixed-rate receiver knows the net future cash flows of a swap at inception.

Q-53.   Solution: A.

Risk-neutral probabilities are used, and discounting is at the risk-free rate. There is no risk premium incorporated into option pricing because of the use of arbitrage.

Q-54.   Solution: A.

The call option will be in-the-money if the price moves up. An at-the-money call option has an exercise price equal to the underlying asset price. Therefore, a price increase will result in the call option moving in the money, and a price decrease will result in the call option moving out of the money.

Q-55.   Solution: B.

The value of an option is determined by its risk-neutral expectation discounted at the risk-free rate. In a one-period binomial model, the risk-neutral probabilities are determined only by the risk-free rate over the life of the option and the underlying asset's volatility (as measured by the up and down gross returns, Ru and Rd). Because of the ability to construct a perfect hedge of the option using the underlying asset, an option's price is independent of investors' risk aversion and the probability of the underlying price moving up (or down).

Q-56.   Solution: C.

One benefit of derivatives markets is information discovery. Implied volatility reveals information about the risk of the underlying. Increases in implied volatility are an implication of increased market uncertainty.

Q-57.   Solution: B.

u=1.1; d=1/u=0.9

S_u=32×1.1=35.2

S_d=32×0.9=28.8

p_+ = Max (0, 32-35.2) = 0

p_- = Max (0, 32-28.8) = 3.2

π_u = (1+0.06−0.9)/(1.1−0.9) = 0.8

π_d =1− π_u = 0.2

P = (0.8×0 + 0.2×3.2)/1.06 = 0.64/1.06 = 0.60

Q-58.   Solution: A.

Using risk-neutral pricing, we can determine the risk-neutral probability as:

S_u= 7,950 × 1.12 = 8,904

S_d= 7,950 × 0.92 = 7,314

c_+ = Max (8,904-7,880, 0) = 1,024

c_- = Max (7,314-7,880, 0) = 0

π_u = (1 − 0.005 − 0.92)/(1.12 − 0.92) = 0.375

π_d =1− π_u = 0.625

c_0 = (0.375 × 1,024 + 0.625 × 0) / (1 - 0.005) = 384 / 0.995 = 385.93