

# AAQF: 衍生品投资



纪慧诚

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# 1. Definition of Derivative

- **Definition:** A **derivative** is a financial instrument (**contract**) that derives its performance from the performance of an underlying asset.
  - **Buy or Sell Something**
    - ✓ Buy or Sell **now**.
    - ✓ Buy or Sell sometime **in the future**.
  - **Example**
    - ✓ 3 month later → \$3/bottle → purchase water.
    - ✓ 3 month later → \$15/share → purchase stock.
    - ✓ 3 month later → 4% interest rate → borrow \$1million.
    - ✓ 3 month later → 6.5CNY/USD → exchange CNY.
- **Tips**
  - Contracts.
  - Hedge risk vs. Speculate.
  - Derives its performance from the performance of an underlying asset.



## 1. Four Main Derivatives

**Forward contract**

**Futures contract**

**Swap contract**

**Option contract**

### ➤ Forward contract

- A **forward contract** is a **private agreement** that obligates one party to buy and the other party to sell a specific quantity of an underlying asset, at a **set price**, at a **future date**.
- If the future price of the underlying assets increase, the buyer has a gain, and the seller has a loss.



## 1. Four Main Derivatives

Forward contract

**Futures contract**

Swap contract

Option contract

- **A Futures contract** is a specialized version of a forward contract that has been standardized and that trades on a futures exchange.
- A forward contract.
  - Are regulated.
  - Guarantee provided by the exchange through the clearinghouse.
  - the daily settlement for gains and losses.



## 1. Four Main Derivatives

Forward contract

Futures contract

**Swap contract**

Option contract

➤ A Swap contract is a series of forward contracts.

- Exchange a series of cash flows.
- Default risk.



## 1. Four Main Derivatives

Forward contract

Futures contract

Swap contract

**Option contract**

### ➤ An option contract

- The owner has **the right**, but not **the obligation** to conduct a transaction.
- Right and obligations are not equal only in option contract, so the long position need to pay option premium.



## 1. Four Main Derivatives

Forward contract

Futures contract

Swap contract

**Option contract**

### ➤ Basic characteristics of options

- 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





## 2. Classification

- According to contract features: Forward commitment & Contingent claim
  - **Forward commitment:** 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:** is derivative in which the payoffs occur if a specific event happens. → **option** contracts.



## 2. Classification

- According to trading place: Exchange-traded & Over-the-counter traded
  - Exchange-traded: place where traders can meet to arrange their traded. (**A** → **Clearinghouse** → **B**)
  - OTC traded: a decentralized market where buy and sell orders initiated from various locations are matched through a communications network. (**A** → **B**)
- **Difference**

<b>Exchange-traded</b>	<b>Over-the-counter</b>
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



### 3. Main terminology

➤ **Forward commitment**

- **Long:** purchase an underlying asset.
- **Short:** sell an underlying asset.

➤ **Contingent claim**

- **Long:** acquire a right.
- **Short:** sell a right.
- **Call:** right to buy.
- **Put:** right to sell.

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## 1. Forward

- **Definition:** A **forward contract** is a bilateral contract that obligates one party to buy and the other party to sell a specific quantity of an underlying asset, at a set price, on a specific date in the future.
- **Long and short forward position**
  - **Long:** buy underlying.
  - **Short:** sell underlying.
  - No payments will be made at the inception of a forward contract. So both parties of a forward contract is exposed to potential default risk.



## 1. Forward

### ➤ **Forward contracts classification**

- Commodity forward contract;
- Financial forward contract.

### ➤ **Purposes of trading forward contracts**

- Hedge risk: Lock the cost in the future, but not sure to make money; Have default risk.
- Speculation: gambling the price movement.

### ➤ **Characteristics of Forward contracts**

- Each party are exposed to **default risk** (or **counterparty risk**);
- Zero-sum game.



## 1. Forward

### ➤ Settling a forward contract at expiration

- **Physical settlement:** deliver an actual asset, has storage cost, mostly used in commodity forward.
- **Cash settlement:** the party that has a position with negative value is obligated to pay that amount to the other party, mostly used in financial forward.

### ➤ Settling a forward contract prior to expiration

- Entering into an opposite forward contract: with an expiration date equal to the time remaining on the original contract.
  - ✓ Offsetting with a **different** party: some credit risk remains.
  - ✓ Offsetting with the **original** party: can avoid credit risk.



## 2. Futures

### ➤ Difference with forward

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





### ➤ Standardization

- Futures contracts specify the quality and quantity of goods that can be delivered, the delivery time and the manner of delivery.

### ➤ 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 participants are allowed by the clearinghouse to reverse their positions in the future.



## 2. Futures

### ➤ Risk control of Futures contract

- Margin;
- Daily Price Limit;
- Marking to market.



### ➤ Risk control of Futures contract

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



## 2. Futures

- Initial margin=\$5/contract, maintenance margin=\$2/contract, long 20 contract

Day	Beginning balance	Funds deposited	Futures price	Price change	Gain/Loss	Ending Balance
0	0	100	82			100
1	100	0	84	2	40	140
2	140	0	78	-6	-120	20
3	20	80	73	-5	-100	0
4	0	100	79	6	120	220
5	220	0	82	3	60	280
6	280	0	84	2	40	320



## 2. Futures

### ➤ Risk control of Futures contract (Con't)

- **Daily Price Limit**

- ✓ Limit on the extent of price movement from the settlement price of the previous trading day.
- ✓ **Limit move:** If traders wish to trade at prices outside these limit---no trades will take place.---the settlement price will be reported upper or lower price limits.
- ✓ **Locked limit:** when the markets hits these limits (limit up or limit down) and trading stops.

- **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.



### ➤ Characteristics of Swap Contracts

- **Swap contract:** A swap contract obligates two parties to change a series of cash flows on periodic settlement dates over a certain time period.
- **Similarity with forward**
  - ✓ No payment required by either party at initiation except the principal values exchanged in currency swaps;
  - ✓ Custom instruments;
  - ✓ Traded in OTC markets(no secondary markets);
  - ✓ Much less regulated;
  - ✓ Subject to default risk;
  - ✓ Institutions dominate.



### ➤ Three types of swap contracts- Interest Rate Swaps

- The **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.



## 4. Option

### ➤ Basic Concepts

- **Definition of option:** An option is 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.
  - ✓ **Call option:** Long call & Short call.
  - ✓ **Put option:** Long put & Short put.
  - ✓ The seller or short position in an options contract is sometimes referred to as the writer of the option.
- **Prices**
  - ✓ **Option premium:** option premium paid by the buyer of option;
  - ✓ **Exercise price:** Strike price (X) represents the exercise price specified in the contract.





## 4. Option Valuation – A Qualitative View

### ➤ Moneyness: on the long position

- **Moneyness**

- ✓ **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.

- The following table summarizes the moneyness of options based on the stock's current price,  $S$ , and the option's exercise strike price,  $X$ .

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



## 4. Option Valuation – A Quantitative View

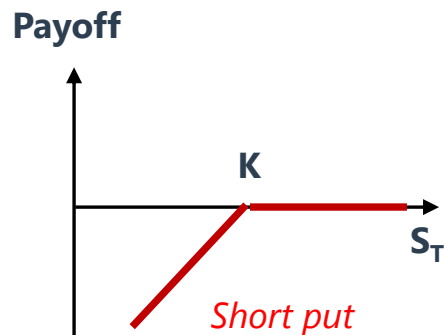
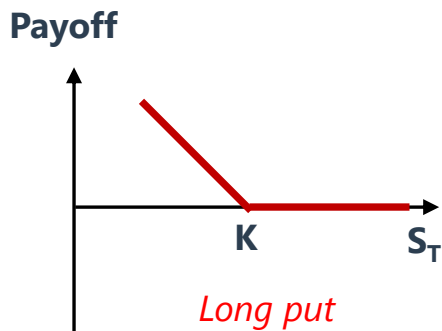
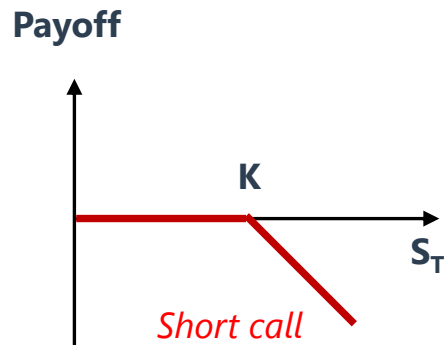
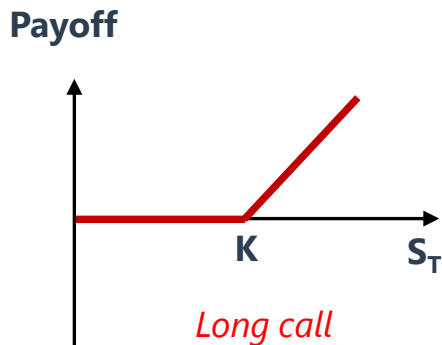
### ➤ Intrinsic Value: on the long position

- **Intrinsic Value:** 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.
  - ✓ **Option value = intrinsic value + time value**
    - ◆ Before expiration: option value > intrinsic value
    - ◆ At expiration: option value = intrinsic value
  - ✓ Price of the option is **more volatile** than prices of underlying stock.



## 4. Option Payoff – An Illustrative View

### ➤ Payoff





## 4. Option: Put call parity

### ➤ Put call parity

- Put call parity.  $c + X/(1 + R_f)^T = S + p$   
or  $c + K/(1 + R_f)^T = S + p$
- Positions replicating
  - ✓ Condition A  $-s = -c + p - X/(1 + R_f)^T$
  - ✓ Condition B  $p = c + X/(1 + R_f)^T - S$
  - ✓ Condition C  $c = p + S - X/(1 + R_f)^T$
  - ✓ Condition D  $-p = -c + S - X/(1 + R_f)^T$
  - ✓ Condition E  $-c = -p + X/(1 + R_f)^T - S$



## Risk Factors on Option Valuation

- Factors affect the value of an option

Sensitivity Factor	Calls	Puts
Underlying price	Positively related	Negatively related
Volatility	Positively related	Positively related
Risk-free rate	Positively related	Negatively related
Time to expiration	Positively related	Positively related*
Strike price	Negatively related	Positively related
Payments on the underlying	Negatively related	Positively related
Carrying cost	Positively related	Negatively related

- \* There is an exception to the general rule that European put option thetas are negative. The put value may increase as the option approaches maturity if the option is deep in-the-money and close to maturity.

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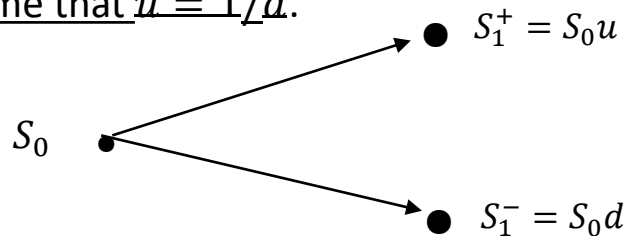
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- A **binomial model**: for pricing options in which the underlying price can move to only one of two possible new prices.
- We start off by having only one binomial period, which means that the underlying price moves to two new prices at option expiration. 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  $S_1^- = S_0 d$ . We further assume that  $u = 1/d$ .





## Option Pricing – Binomial Model

- Risk-neutral probability of an up move is  $\pi_u$  ; Risk-neutral probability of a down move is  $\pi_d = 1 - \pi_u$ .

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

- We start with a call option. If the stock goes up to  $S_1^+$  , the call option will be worth  $C_1^+$  . If the stock goes down to  $S_1^-$  , the call option will be worth  $C_1^-$  . We know that the value of a call option will be its intrinsic value on expiration date. Thus we get:  $C_1^+ = \text{Max}(0, S_1^+ - X)$ ;  $C_1^- = \text{Max}(0, S_1^- - X)$

$$\text{Value of an option: } c = [\pi_u C_1^+ + \pi_d C_1^-] \times \frac{1}{(1+R_f)^T}$$

- Hedge ratio

$$\text{Delta} = \frac{C^+ - C^-}{S^+ - S^-} \text{ (shares per option)}$$





- Calculate the value today of a 1-year call option on the stock with the strike price of \$20. The price of the stock is \$20 now, and the size of an up-move is 1.25. The risk-free rate is 7%.

- **Correct Answer:**

- **Step 1: Calculate the parameters:**

- ✓  $u=1.25$ ;  $d=1/u=0.8$ ;  $S_u=20 \times 1.25=25$ ;  $S_d=20 \times 0.8=16$

- ✓  $C^+ = \text{Max}(0, 25-20) = 5$ ;  $C^- = \text{Max}(0, 16-20) = 0$

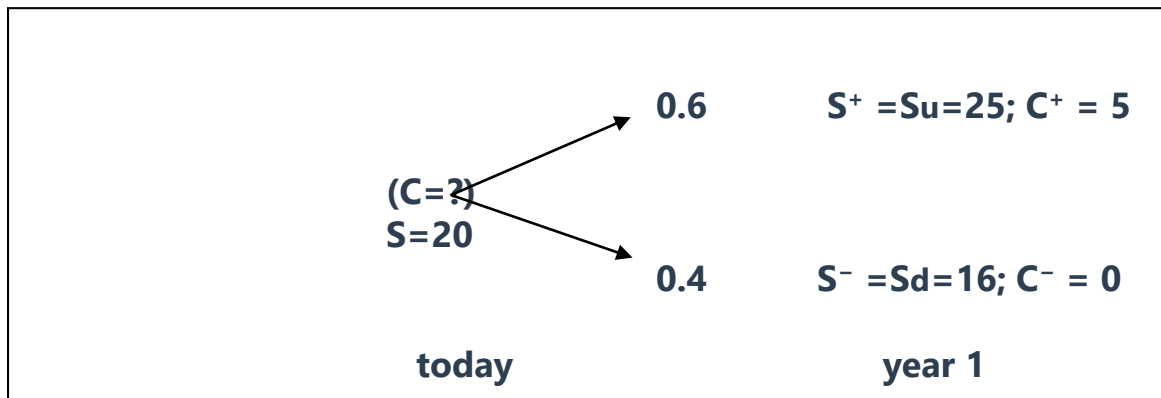
- **Step 2: Calculate risk-neutral probabilities:**

- ✓  $\pi_u = (1+0.07-0.8)/(1.25-0.8) = 0.6$

- ✓  $\pi_d = 1 - \pi_u = 0.4$



➤ **Step 3: Draw the one-period binomial tree**





## Option Pricing – Binomial Model (2)

- Pricing a put option is similar to that of a call. The only difference is that  $P^+ = \text{Max}(0, X -$









It's not the end but just the beginning.

Never stop smiling, not even when you're sad, someone might fall in love with  
your smile.

永远都不要停止微笑，即使是在你难过的时候，说不定有人会因为你的笑容  
而爱上你。

# 金程教育·匠心出发·质量万里行-开启24h学员满意度提升通道

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