# Options and Risk Models

## FRM一级培训讲义-强化班

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101% Contribution Breeds Professionalism



## Topic Weightings in FRM Part Ⅰ

| Session NO. | Contents | Weightings |
|---|---|---|
| Study Session 1 | Foundations of Risk Management | 20 |
| Study Session 2 | Quantitative Analysis | 20 |
| Study Session 3 | Financial Markets and Products | 30 |
| Study Session 4 | Valuation and Risk Models | 30 |







## Framework

- Option Markets
- Financial Institutions
- Market Risk Models
- Credit Risk Models
- Operational Risk Models

# Options Market





## Properties of Stock Options

- **Basics**
  - Call and Put Options
  - European and American Option
- **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 result in a loss
- **Intrinsic Value and Time Value**
  - **Intrinsic Value:** The amount that it is in the money, and zero otherwise
    - ✓ Intrinsic value of call option: C=max [S – X, 0]
    - ✓ Intrinsic value of put option: P=max [X – S, 0]
  - **Time Value:** The difference between the price of an option (called its premium) and its intrinsic value is due to its time value.

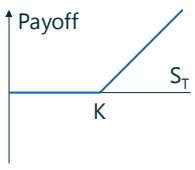




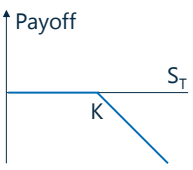


## Calls and Puts

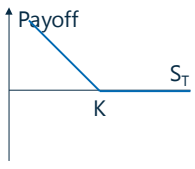
- **Payoffs of Options**



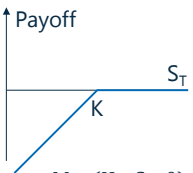

$\text{Max}(S_T - K, 0)$




$-\text{Max}(S_T - K, 0)$




$\text{Max}(K - S_T, 0)$




$-\text{Max}(K - S_T, 0)$

## Properties of Options

- **Call Options**

| Call Option | Upper Bounds | Lower Bounds |
|---|---|---|
| European (No Dividend) | $S_0$ | $\max(S_0 - PV(K), 0)$ |
| European (Dividend) | $S_0$ | $\max(S_0 - PV(K) - PV(Divs), 0)$ |
| American (No Dividend) | $S_0$ | $\max(S_0 - PV(K), 0)$ |
| American (Dividend) | $S_0$ | 视红利情况而定 |

- **Put Options**

| Put Option | Upper Bounds | Lower Bounds |
|---|---|---|
| European (No Dividend) | PV(K) | $\max(PV(K) - S_0, 0)$ |
| European (Dividend) | PV(K) | $\max(PV(K) + PV(Divs) - S_0, 0)$ |
| American (No Dividend) | K | $\max(K - S_0, 0)$ |
| American (Dividend) | K | 视红利情况而定 |

- **Put-Call Parity** $\text{European Call Price} + PV(K) + PV(Divs) = \text{European Put Price} + S$





## Properties of Options

- What will be the lower bound for the price of a three-month European put option on a non-dividend-paying stock if the current stock price is USD 22, the strike price is USD 25, and the risk-free rate is 6% per year (annually compounded)?
  - The lower bound (USD) is

$$\max(PV(K) - S_0, 0) = \frac{25}{(1+0.06)^{0.25}} - 22 = 2.64$$

- The current price of a non-dividend-paying stock is USD 29 and the price of a four-month call option on the stock with a strike price of USD 30 is USD 2. The risk-free rate is 4% per annum (annually compounded). What is the price of a four-month put option on the stock with a strike price of USD 30? Assume no arbitrage opportunities exist.
  - By put-call parity: Put= Call +PV(K)-S
  - The put price(USD)is thus given by: $2 + \frac{30}{1.04^{1/3}} - 29 = 2.61$

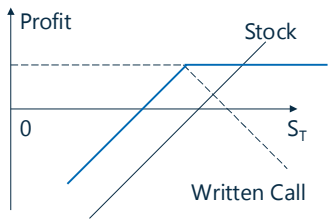




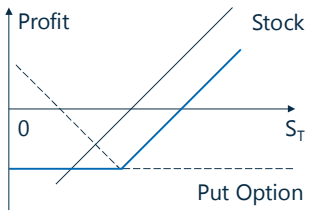


## Simple Strategies

- **Covered Call and Protective Put**




Covered Call = -C + S

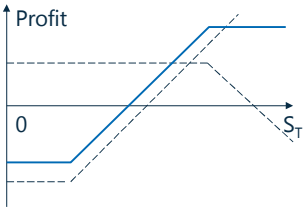



Protective Put = S + P

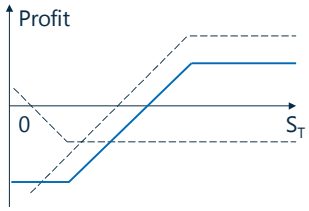
- **Principal Protected Notes(PPN)**
  - A PPN is structured as a zero-coupon bond and an option with a payoff that is linked to an underlying asset, index, or benchmark.
  - It guarantees a minimum return equal to the investor's initial investment (the principal amount), regardless of the performance of the underlying assets.

## Spread Strategies

- **Bull Spread**
  - Vertical spread, outlook is bullish




Bull Call Spread



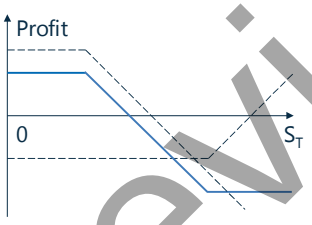

Bull Put Spread



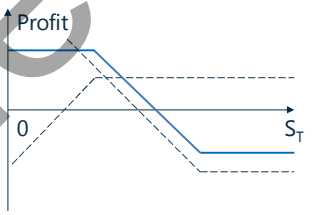


## Spread Strategies

- **Bear Spread**
  - Vertical spread, outlook is bearish




Bear Call Spread




Bear Put Spread

- **Box Spread**
  - A box spread is a combination of a bull call spread with strike prices $K_1$ and $K_2$ and a bear put spread with the same two strike prices.
  - The payoff from a box spread is always $K_2 - K_1$.

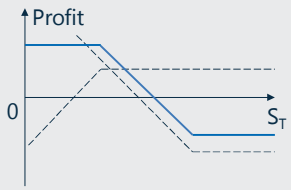






## Spread Strategies

- A trader creates a bear spread using put options with strike prices of USD 25 and USD 30 and the same time to maturity. The options cost USD 2 and USD 4.50(respectively). Under what circumstances will the trade be profitable?




  - It costs USD 2.50 to set up the bear spread.
  - The trade will be profitable if the price of the asset at maturity is less than USD 27.50