Exam Express - FRM P1

高顿财经
GOLDEN FINANCE

Financial Markets and Products

Weight: 30%

Content

Session 1: Financial Institutions

1. Banks (☆)
2. Insurance Companies and Pension Plans (☆)
3. Mutual Funds and Hedge Funds (☆)

Content

Session 2: Introduction of Derivatives

4. Introduction of Derivatives (☆ ☆)

Content

Session 3: Forward Commitments

5. Interest Rates (☆ ☆)
6. Interest Rates Futures (☆ ☆ ☆)
7. Swaps (☆ ☆ ☆)
8. Commodity Forwards and Futures (☆)

Content

Session 4: Futures Valuation and Application

9. Mechanics of Futures Markets (☆)
10. Determination of Forward and Futures Prices (☆ ☆ ☆)
11. Hedging Strategies Using Futures (☆ ☆ ☆)
12. Foreign Exchange Risks (☆ ☆)

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Session 5: Options

13. Mechanics of Options Market (☆)
14. Properties of Stock Options (☆ ☆ ☆)
15. Trading Strategies Involving Options (☆ ☆ ☆)
16. Exotic Options (☆)

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Session 6: Central Counterparties

17. Exchanges, OTC derivatives, DPCs and SPVs (☆)

18. Basic Principles of Central Clearing (☆)

19. Risks Caused by CCPs (☆)

Content

Session 7: Fixed Income

20. Corporate Bonds (☆ ☆)

21. Mortgages and Mortgage-Backed Securities (☆ ☆)

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Session 1

Bank Introduction

Commercial Banking

- Retail bank vs. wholesale bank: strict regulation
- Risks: credit, market, and operation
- Capital: economic vs. regulatory
- Deposit insurance: insure against losses up to a certain level, but incur moral hazards

Bank Introduction

Investment Banking

- Private placement
- Public offering
  - ✓ Best effort: work as a broker
  - ✓ Firm commitment: work as a dealer
  - ✓ IPO: price paid by all successful bidders is the lowest bid
- Accounting
  - ✓ Banking book: not mark-to-market
  - ✓ Trading book: mark-to-market (model)
- Securitization means originate-to-distribute model.

Bank

Potential Conflicts

- Many conflicts may arise between commercial banking, securities services and investment banking when they are under the same umbrella.
  - ✓ The “advisor” is also the “seller” problem.
  - ✓ Pass inside information from lending arm to M&A arm.
  - ✓ Research independence is in question for companies investment bank want to have business with.
  - ✓ Dump the “garbage” on the banking book through investment bank.

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Session 1

Insurance

Insurance Category

- Life insurance
  - ✓Term life insurance: 非终生寿险 mortgage funding
  - ✓Whole life insurance: 终生寿险 use as collateral
  - ✓Variable life insurance: 可变险 surplus invested by policyholders, minimal payout guaranteed
  - ✓Universal life insurance: 万能险 premium could reduce down to a specified minimum, two payment option
  - ✓Variable-universal life insurance: 可变万能险 policyholder chooses from some choices
  - ✓Endowment life insurance: 定期寿险 die or end
    - Pure endowment: paid only when survive at the end
  - ✓Group life insurance: 团体寿险 (小额赔付、不体检）
- Property-casualty insurance
- Health Insurance

Annuity and Pension Plan

Annuity

- It starts at a particular date and last for the rest of policyholder's life. With tax deferral advantages and potential options embedded.

Pension plan

- Defined benefit (DB): company bears risks
- Defined contribution (DC): worker bears risks

Seminar 1: Life Insurance Breakeven Premium

Mortality Table

- Male infant aged 1 needs to insure for 2-year term of ￥200,000, with interest rate 2% and semiannual compounding, what is the breakeven premium with the payouts halfway in the year?

Age (Years)	Probability of Death within 1 Year	Survival Probability	Life Expectancy
0	0.006990	1.00000	75.90
1	0.000447	0.99301	75.43
2	0.000301	0.99257	74.46
3	0.000233	0.99227	73.48

Seminar 1: Life Insurance Breakeven Premium

Payout

- End of age 1: 0.000447*200,000=89.4
  - ✓ Discounted: 89.4/1.01=88.51
- End of age 2: (1-0.000447)*0.000301*200,000=60.17
  - ✓ Discounted: 60.17/1.01^3=58.40
- Sum of the two above: 146.91

Premium

- Beginning of age 1: X
- Beginning of age 2: (1-0.000447)*X/1.01^2=0.9799X
- Sum of the two above: 1.9799X

Solution

- X=146.91/1.9799=74.21

Risks and Ratios

Risks

- **Longevity risk**: live too long
  - ✓ Good for life insurance, bad for annuity
- **Mortality risk**: live too short
  - ✓ Good for annuity, bad for life insurance

Ratios

- **Loss Ratio**=payouts/premiums earned
- **Expense Ratio**=expenses/premiums earned
- **Combined Ratio**= *Expense Ratio* + *Loss Ratio*
- **Combined Ratio after dividend**= *Combined Ratio*+ dividend
- **Operating Ratio**=*Combined Ratio after dividends*-investment Income(%)=*Combined Ratio* + dividend-investment Income

Adverse Selection and Moral Hazard

Adverse selection

- It happens before the deal works.

Moral hazard

- It happens after the deal works.

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Session 1

Funds

Funds Category

- **Open-end fund:** buy or redeem at next-calculated NAV

$$\text{NAV} = \frac{\text{funds assets} - \text{fund liabilities}}{\text{total shares outstanding}}$$

- **Close-end fund:** trade like stocks, and fixed number of shares outstanding
- **ETF:** buy or redeem through a basket of stocks, and also could trade like close-end fund

Mutual and Hedge Funds

Hedge fund profile

- 2 plus 20
- Hurdle rate
- High-water mark clause

	Mutual Fund	Hedge Fund
NAV calculation	Daily	Longer period
Investment policy	Full disclosure	Not full disclosure
Leverage	Limited use	High leverage
Redeemability	Redeemable at any time	Usually lock-up period exists

Hedge Funds Strategies and Bias

Strategies

- Long/short equity, dedicated short, distressed securities, merger/fixed income/convertible arbitrage, emerging markets, global macro, managed futures

Bias

- **Survivorship bias**: overestimate return of industry
- **Backfill bias**: backfill only good strategies
- **Stale price bias**: underestimate volatility
- **Self-selection bias**: only good players choose to report

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Session 2

04 Introduction of Derivatives

Derivatives

Classification

- **Forward commitment:** bilateral contract
  - ✓ **Forward**: customized contract
  - ✓ **Futures**: standardized contract, exchanged-traded market, and daily settlement (mark-to-market).
    - Margin: Initial margin, maintenance margin.
    - Margin call: bring back to initial margin level.
  - ✓ **Swap**: a series of off-market forward contracts
    - Interest rate swap

Derivatives

Classification

- **Contingent claims:** unilateral contract
  - ✓ Only the right, not the obligation
  - ✓ **Option**: the long pays the premium for the right to buy or sell the underlying.
    - long a call: right to buy; short a call: obligation to sell.
    - long a put: right to sell; short a put: obligation to buy.
  - ✓ **Credit derivatives**: the long pays the premium for the credit protection from the short, a kind of special put option, such as credit default swap (CDS).

Arbitrage

Arbitrage

- Two assets or portfolios produce identical results but sell for different prices.
- **Law of one price**: assets that produce identical future cash flows regardless of future events should have the same price.
  - ✓Asset + Derivative = Risk-free asset
- **No arbitrage pricing**: price of a derivative by assuming that there are no arbitrage opportunities (no arbitrage pricing).
- The functions of derivatives market are price discovery and transfer price risk.

Exchange Market and OTC Market

OTC (over-the-counter)	Exchange Traded
Customized	Standardized
Trade with counterparty (default risk)	Backed by a clearing house
Not trade in a central location	Trade in a physical exchange
Unregulated	Regulated
Large trading volume	Small trading volume

CONTENTS

Session 3

Rates and Theories of Term Structure

Three kinds of rates

- Treasury rates, LIBOR, and repo rates.

Three theories of term structure

- Pure expectations theory
  - ✓ Long-term interest rates should reflect expected future short-term interest rates, rates hedge is useless.
- Liquidity preference (premium) theory
  - ✓ Long-term interest rate is higher than short-term rates.
- Segmentation theory
  - ✓ Supply and demand for specific maturity ranges determines interest rates, and segmentation of term exists.

Spot Rates, Bootstrapping, and Par Yield

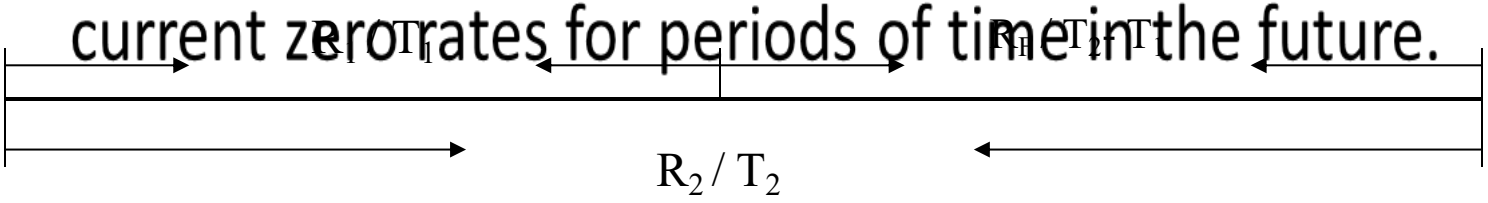
Spot rates

- **Spot rates** are the rates that correspond to zero-coupon bond yields.
- **Bootstrapping**: short-term spot rates are derived from zero-coupon bonds, and longer-term spot rates could be computed using the bootstrapping methodology.
- **Par yield** for a certain bond maturity is the coupon rate that causes the bond price to equal its par value.

Forward Rates

Forward rates

- **Forward rates** are the future rates of interest implied by current zero rates for periods of time in the future.



- $R_F = \frac{R_2 \times T_2 - R_1 \times T_1}{T_2 - T_1}$

- $R_F = R_2 + \frac{R_2 - R_1}{T_2 - T_1} \times T_1$

Seminar 2: Term Structure

- If you believe that the liquidity preference theory is an accurate characterization of the behavior of zero curve under continuous compounding. Assuming that the liquidity theory holds, which of the following is the highest?

A. 1-year forward rate

B. 2-year par rate

C. 2-year zero bond

D. YTM of 2-year coupon bond trading at par

Seminar 2: Term Structure

- **Answer: A**
- B is same as D, par rate is the proper coupon rate which makes bond trade at par, so it is also the YTM of this bond.
- C is the spot rate on 2-year point. During a upward curve circumstance, 2-year is higher than 1-year, and YTM of 2-year is somewhat a weighted-average rate of 1-year and 2-year. So 2-year spot is higher than 2-year YTM. Furthermore, forward is higher than 2-year spot because the term structure is upward.

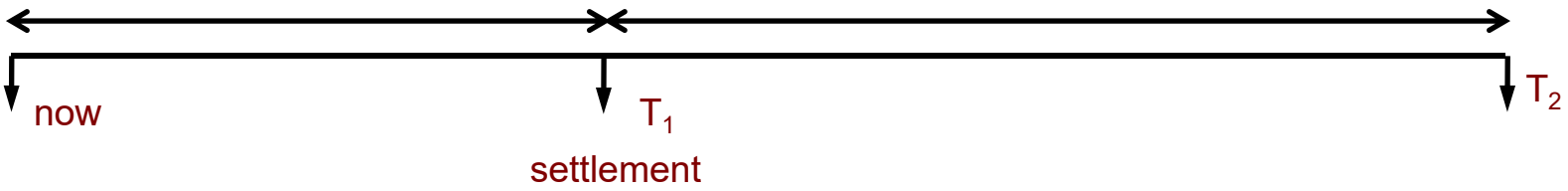
Forward Rate Agreement (FRA)

FRA Introduction

- **A FRA** is an over-the-counter (OTC) forward contract in which the underlying is an interest rate (e.g. Libor).
  - ✓ **Long position** is borrower, who could benefit from interest rate increasing.
  - ✓ **Short position** is lender, who could benefit from interest rate decreasing.
  - ✓ FRA locks the interest rate, and one party will pay the other party the difference.

Forward Rate Agreement (FRA)

FRA Calculation



- **Value of long position**

✓ $Principal \times (R_{real} - R_{forward}) \times (T_2 - T_1) \times e^{-R_2 \times T_2}$

CONTENTS

Session 3

Fundamental of Bonds

Day count and quotation

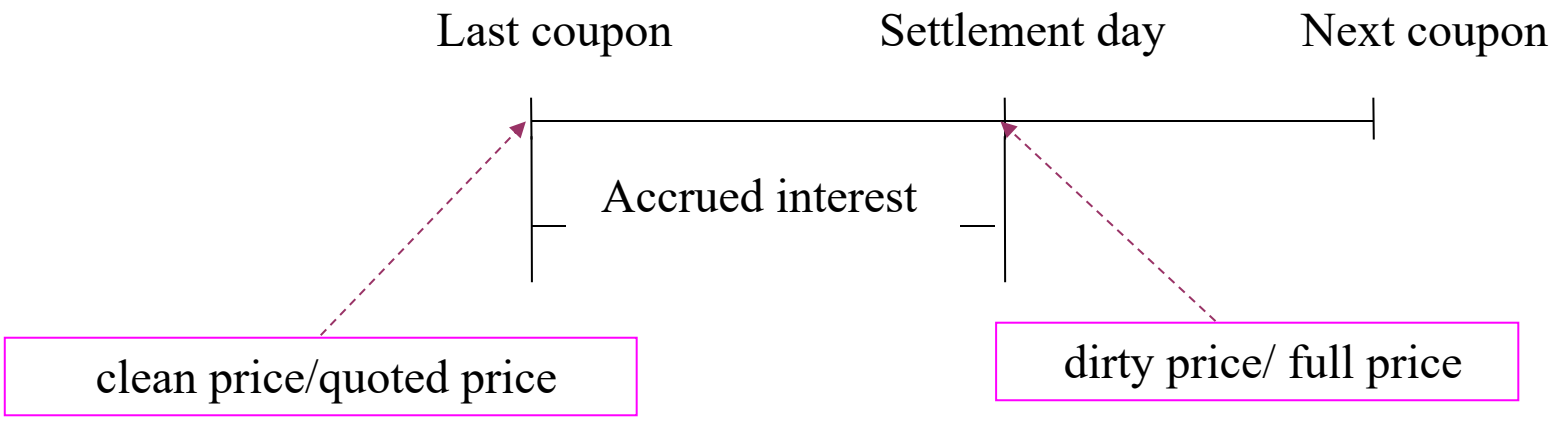
- Day counting convention: US Treasury bonds uses actual/actual, US corporate and municipal bonds use 30/360, U.S Treasury bills use actual/360.
- Quotation
  - ✓ For bill: $quoted\ Price = \frac{360}{n}(100 - \text{cash price})$
    - Quoted price is 100×discount rate
    - $Cash\ price = 100 \times \left(1 - discount\ rate \times \frac{n}{360}\right)$
  - ✓ For bond: dollar and 32 of a dollar

T Bond Quotation and Pricing

Quotations for T-Bond

- Full (dirty) price = clean price + accrued interest
  - ✓ Clean price = dirty price – accrued interest

$$accured\ \text{interest} = \text{coupon} \times \frac{\#\ of\ days\ from\ last\ coupon\ to\ the\ settlement\ date}{\#\ of\ days\ in\ coupon\ period}$$



Interest Rate Futures

Two most popular interest rate futures

- T-bond futures (CBOT) -physical delivery, $100,000 face value
  - ✓ Quotations of contracts: dollar and 32 of a dollar
  - ✓ Cheapest to deliver: cost=quoted bond price – (QFP × CF)
- Eurodollar futures (CME) -cash settled, $1m face value
  - ✓ Basic feature: T_2-T_1=3 month, $25 per bp changes
  - ✓ Convexity adjustment: $Actual\ forward\ rate = forward\ rate\ implied\ by\ futures - 0.5 \times \delta^2 \times T_1 \times T_2$
  - ✓ Extend LIBOR zero curve: $R_2 = \frac{R_{forward}(T_2 - T_1) + R_1 T_1}{T_2}$

Duration-based Hedging

Duration-based hedging

$$N = -\frac{P \times D_P}{F \times D_F}$$

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Session 3

Plain Vanilla Interest Rate Swaps

Plain vanilla interest rate swaps

- Taking own strength and exchange it for its need
- Total benefit: the difference between the two method of finance rates' difference of two party
  - ✓ "蛋糕"即双方固定筹资成本差额和浮动筹资成本差额的差额
- Notional amount is not exchanged, and interest payments are netted (only greater amount paid).
- Floating rate payments are typically made in arrears, payment is made at end of period based on beginning-of-period LIBOR.

Plain Vanilla Interest Rate Swaps

Plain vanilla interest rate swaps (Cont.)

- Fixed-rate payment (at time t)
  - ✓ $(fixed\ rate - LIBOR_{t-1}) \times \frac{T}{360} \times NP$
  - ✓ Swap rate is the rate paid by the pay-fixed side.
- **Value of payer swap** = value of "replicating" floating rate bond – value of "replicating" fixed rate bond
  - ✓ On each settlement date, the value of a floating rate note (FRN) will always reset to par.

Currency Swaps

Currency Swaps

- The value of one side is the difference between the cash it should receive minus the cash it should pay.
  - ✓ Calculating value must use the same currency.

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Session 3

Commodity Forwards and Futures

Basis and basis risks

- **Basis** is the difference between the spot price and the futures price on the same commodity at any given time.
- **Basis risk** is the volatility of the basis over time and as a result is usually represented as the variance of the basis:

$$\sigma^2_{S(t)-F(t)} = \sigma^2_{S(t)} + \sigma^2_{F(t)} - 2\sigma_{S(t)}\sigma_{F(t)}\rho_{S,F}$$

- **Market depth** is the maximum trading amount which would not move the price.

Commodity Forwards and Futures

Commodity pricing

- $F_0 = S_0 \times e^{(r+u-y)t}$
  - ✓ Cash and carry: buy spot and sell forward
  - ✓ Reverse cash and carry: sell spot and buy forward
- Commodity characteristics
  - ✓ **Corn** is seasonality, long term **oil price** is less volatile, and **natural gas** is regional, costly to store, seasonal. **Electricity**' demand is not constant and would not store. **Gold** mine is assumed to operate, synthetic gold better.
- **Strip hedge** is item-by-item hedge, and **stack hedge** is using the same derivative instrument to hedge all targets.

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Session 4

Futures Market

Basis and basis risks

- **Clearing** is the process by which trades in futures and options are processed, guaranteed, and settled by an entity known as a clearing house.
- The clearinghouse manages margin accounts, and it could reduce credit risk and provide liquidity.

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

Futures Market

Margin and limit

- **Initial margin**: margin call would push investor top up the margin account back to the initial margin level.
- **Maintenance margin**: minimal amount investor should hold.
  - ✓ **Variation margin** = initial margin – margin account balance
- Exchange would set a limit on the daily price movement, minimal and maximal price.
  - ✓ It would decrease fluctuation, supply more time to digest, but decrease market efficiency.

Seminar 3: Margin Call Calculation

满血复活法

- Jarod, CFA, sets 10 contracts of short positions in cotton futures (5 tons per contract) of Zhengzhou, which asked for ￥18,000 as initial margin and ￥15,000 as maintenance margin. Today is 31 Oct, and price is 14,800. Which date should he be margin call? What is the amount on 10 Nov?

Date	Price per ton	Date	Price per ton
Nov 1	14,760	Nov 6	14,810
Nov 2	14,700	Nov 7	14,825
Nov 3	14,640	Nov 8	14,900
Nov 4	14,720	Nov 9	15,080
Nov 5	14,790	Nov 10	15,000

Seminar 3: Margin Call Calculation

满血复活法

- Maximum amount without margin call = $\frac{18000-15000}{10\times5} = 60$
- First point is price above 14,800 + 60 = 14,860, Nov 8 (14,900), then margin call, account is back to initial amount.
- Second point is price above 14,900 + 60 =14,960, Nov 9 (15,080), then margin call.
- On Nov 10, price between Nov 10 and the nearest margin call point (Nov 9) is 80 (earn). So the account should plus 80*5*10=4,000, total is 18,000 + 4,000 = 22,000.

Order and Settlement

Type of order

- Market order vs. limit order
- Stop order (market if touched) vs. stop limit order

Ways to Terminate

- Physical delivery
- Cash settlement
- Reverse trading
- Exchange for physicals

CONTENTS

Session 4

Forward and Futures Price

Forward and futures price

- Cost rate and return rate
  - ✓ $F = Se^{(r+u-y)\times T}$
- Cost expense and return value
  - ✓ $F = (S + U - I)e^{rT}$
- Contango (forward>spot) and backwardation (spot>forward)
- Delivery option
  - ✓ c > y: short position to deliver early
  - ✓ c < y: short position to deliver late

CONTENTS

Session 4

Effect of Hedge

Effect of Hedge

- Reduce price risk
- Less impact on the company
- Less profitability

Basis and Basis Risk

Basis and basis risk

- Basis = spot price – future price
- Different asset, different maturity, and the requirement of futures closing out before delivery month are the three reasons of basis risk.
- Hedge effect
  - ✓ Without hedge price S_2
  - ✓ Hedge price $F_1 + (S_2 – F_2) = F_1 + b_2$
- Cross hedge
  - ✓ Futures asset is different with underlying asset

Hedging Strategies Using Future

Formula

- Optimum hedge ratio: $h = \rho_{s,f} \times \frac{\sigma_s}{\sigma_f}$
- Hedge effectiveness: $\rho^2 = R^2 = h^2 \times \frac{\sigma_f^2}{\sigma_s^2}$
- Optimum number of contract: $N^* = h\frac{N_A}{Q_f}$
- Stock index futures
  - ✓ Diminish to zero: $N^* = \beta \times \frac{P}{A}$
  - ✓ Adjust to β^*:$N^* = (\beta^* - \beta) \times \frac{P}{A}$

Using Futures to Hedge

Rollover

- When the hedging horizon is long relative to the maturity of the futures used in the hedging strategy, hedges have to be rolled forward as the futures contracts in the hedge come to maturity or expiration.
- When rolling a hedge forward, hedgers are not only exposed to the basis risk of the original hedge, they are also exposed to the basis risk of a new position each time the hedge is rolled forward. This is referred to as rollover basis risk, or simply rollover risk.

CONTENTS

Session 4

Foreign Exchange Risk

Foreign exchange risk

- A positive net exposure position means net long in a currency, while negative net exposure position means net short in a currency.
- In direct quotation, $F = Se^{(r_{dc}-r_{fc})T}$
- **On balance sheet hedging** means setting matched maturity and currency foreign asset-liability book, while **off balance sheet hedging** means taking a position in the forward market.

CONTENTS

Session 5

Introduction of Options

Introduction

- Call option vs. put option
- European option vs. American option
- Strike price, premium, and expiration date
- Profit for call = Max(0, S_T - X) - c_0
- Profit for put = Max(0, X - S_T) - p_0
- 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

Option Position

	Long call	Short call	Long put	Short put
Payoff at T	$Max(S_T - X,0)$	$-Max(S_T - X,0)$	$Max(X - S_T,0)$	$-Max(X - S_T,0)$
P/L at T	$Max(S_T - X,0) - Pm$	$-Max(S_T - X,0) + Pm$	$Max(X - S_T,0) - Pm$	$-Max(X - S_T,0) + Pm$
Max. profit	Unlimited	Pm	X - Pm	Pm
Max. loss	Pm	Unlimited	Pm	X - Pm
Breakeven	X + Pm	X + Pm	X - Pm	X - Pm

Options

Options

- **Non-standard options** include options on exchange-traded funds, weeklys, binary options, credit event binary options (CEBOs), DOOM options, effect of dividends and stock splits.
- Market maker and buy on margin
- Naked option vs. covered option
- Options Clearing Corporation (OCC) is similar with clearing house of an exchange.

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Session 5

Six Factors that Affect Option Prices

Factor	European call	European put	American call	American put
S	+	—	+	—
X	—	+	—	+
T	?	?	+	+
σ	+	+	+	+
r	+	—	+	—
D	—	+	—	+

European Option vs. American Option

No dividend vs. with dividend

- No dividend
  - ✓ American call options = European call options
  - ✓ American call never exercise early.
  - American put options can be delivered early, especially X-S is large and interest rate is high.
- With dividend
  - Both American call and put options can be delivered early.
- Whether to early exercise is determined by the cash flow and risk-free interest rate.

European Option vs. American Option

Upper and lower pricing bounds and put-call parity

- Put-call parity: $p + S = c + Xe^{-rt}$

Option	proxy	Min Value	Max Value
European call	c	max (0, S_0 — Xe^{-rT})	S_0
American call	C	max (0, S_0 — Xe^{-rT})	S_0
European put	p	max (0, Xe^{-rT} —S_0)	Xe^{-rT}
American put	P	max (0 , X—S_0)	X

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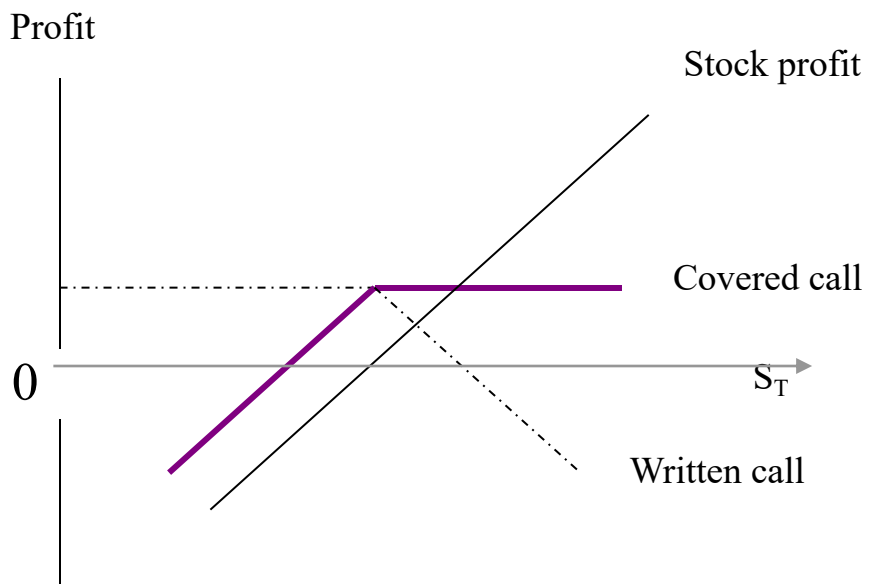
Session 5

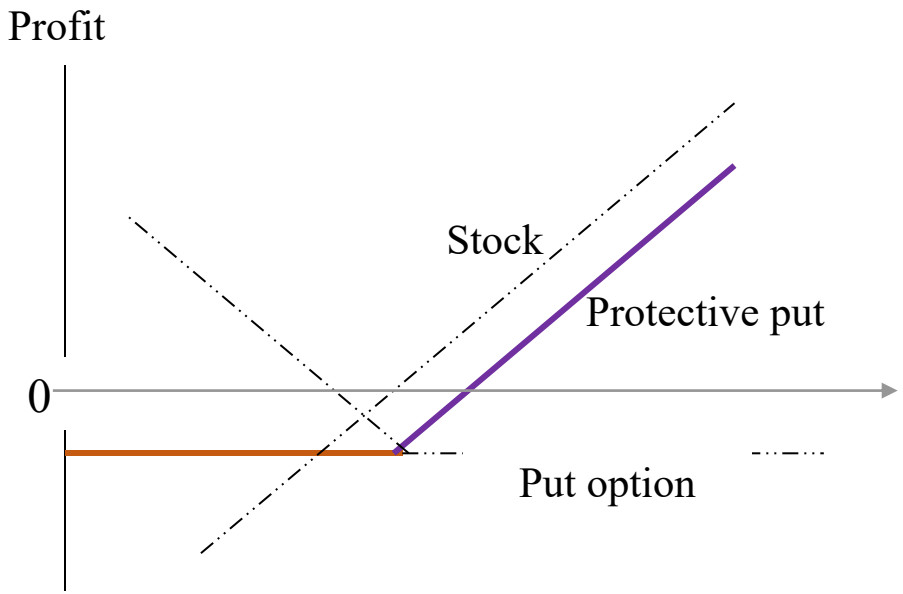
Trading Strategies Involving Options

Covered call (-c+S)



Trading Strategies Involving Options

Protective put (p+S)



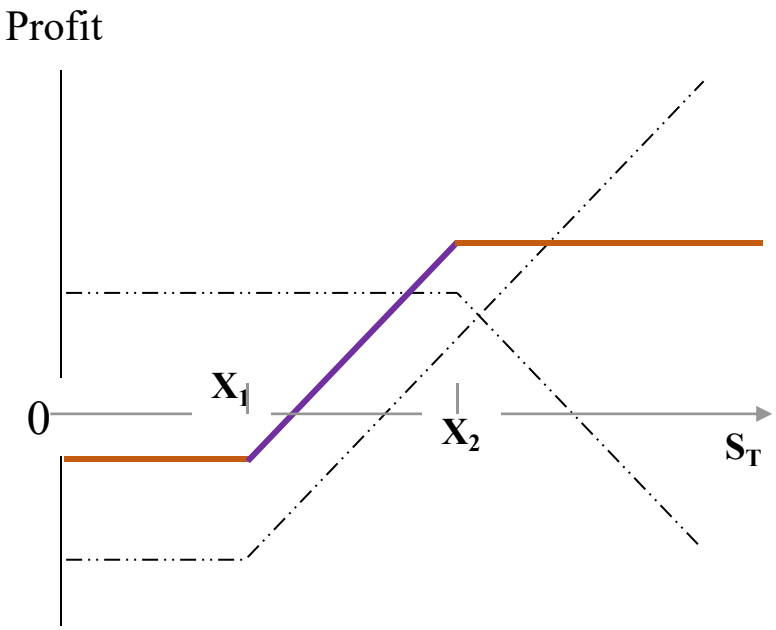
Trading Strategies Involving Options

Spread strategy

- A **spread trading strategy** involves taking a position in two or more options of the same type.
  - ✓ Bull spreads (bull call, bull put)
  - ✓ Bear spreads (bear call, bear put)
  - ✓ Butterfly spreads
  - ✓ Calendar spreads
  - ✓ Diagonal spreads

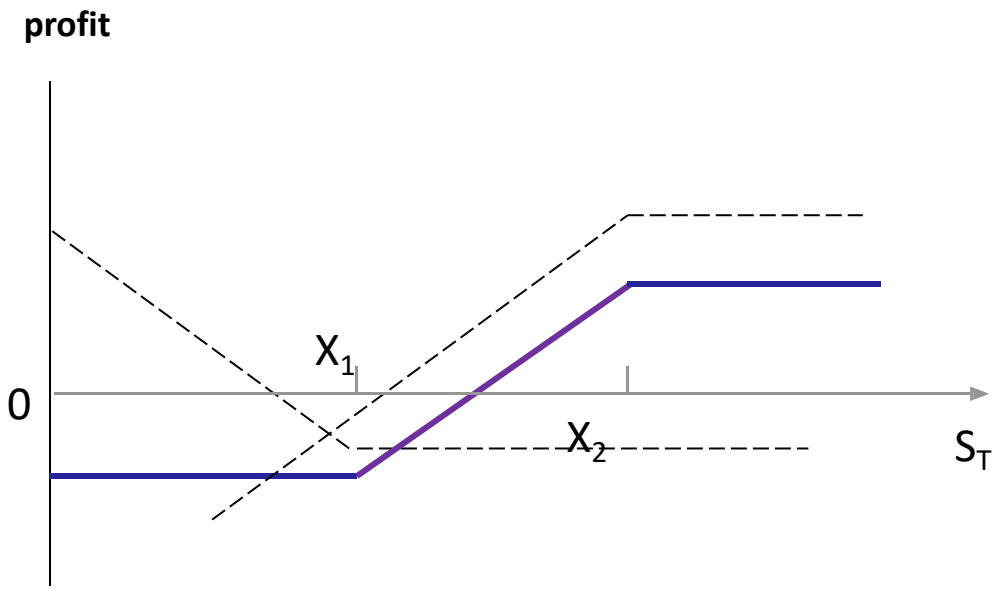
Spread

Bull call spread (long low, short high)



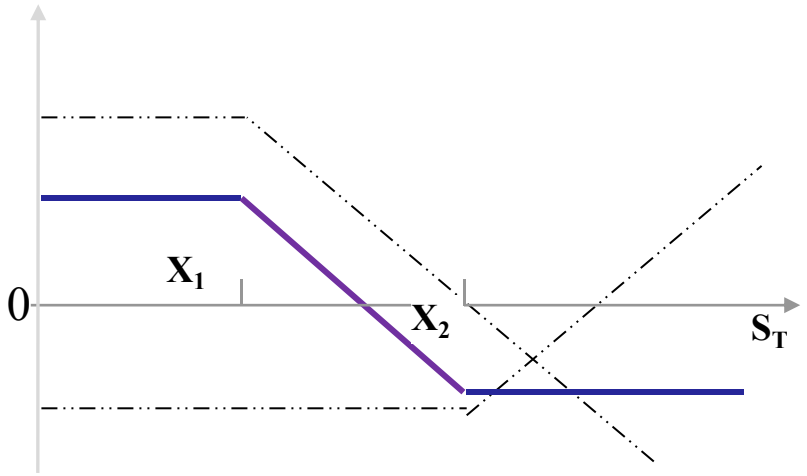
Spread

Bull put spread (long low, short high)



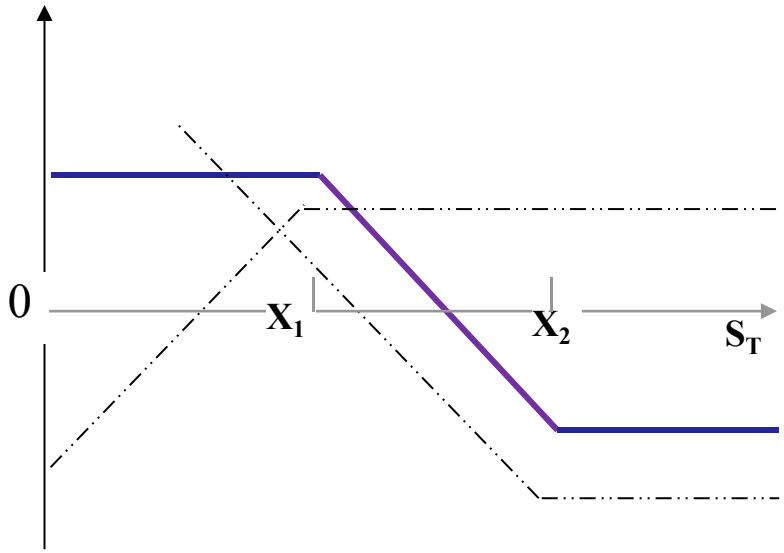
Spread

Bear call spread (long high, short low)



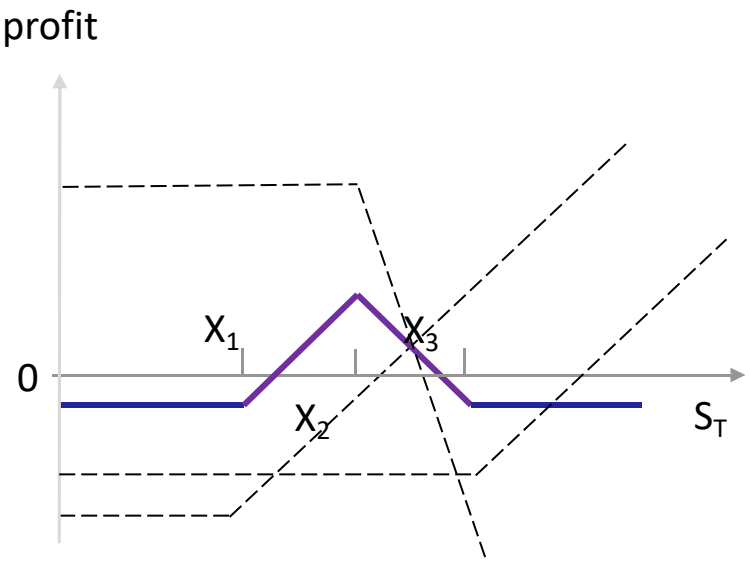
Spread

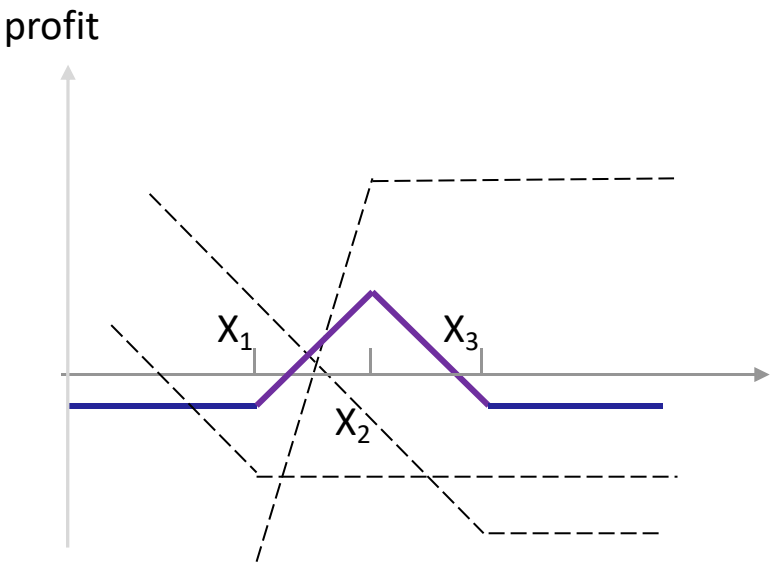
Bear put spread (long high, short low)



Spread

Butterfly spread (long low and high, short 2 middle)





Spread

Calendar, diagonal and box spread

- **Box spread** is a combination of a bull call spread and a bear put spread on the same asset.
- Under a no arbitrage assumption, the present value of the payoff will equal the net premium paid, so the profit will equal zero. Box spread arbitrage is only successful with European options.

	Strike Price	**Expiration**
Calendar Spread	Same	Different
Diagonal Spread	Different	Different

Combination Strategy

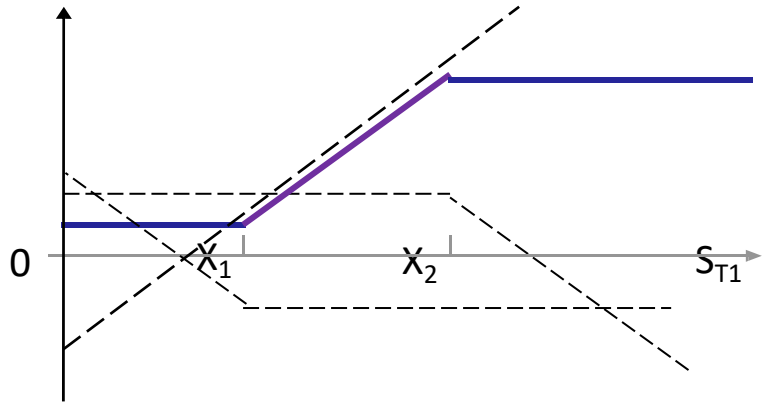
Combination strategy

- A **combination strategy** is an option trading strategy that involves taking a position in both calls and puts on the same stock.
  - ✓ Collar
  - ✓ Straddles
  - ✓ Strangles (bottom vertical combination)
  - ✓ Strips
  - ✓ Straps

Combination Strategy

Collar (S+p-c)

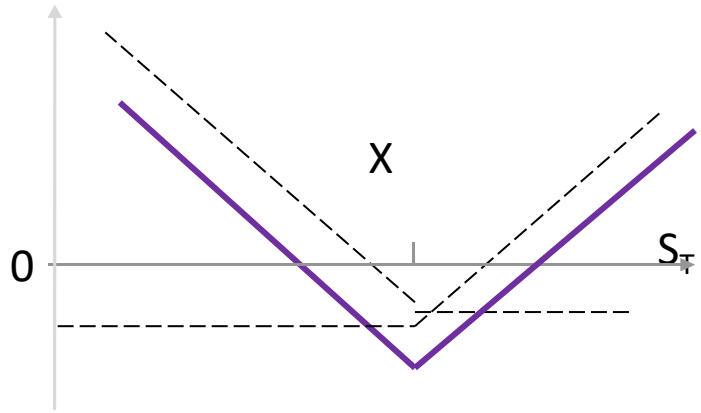
- It is constructed by long 1 share, long put at X_1, and short call at X_2, , $X_1<X_2$. Call and put have same expiration.



Combination Strategy

Straddle (c+p)

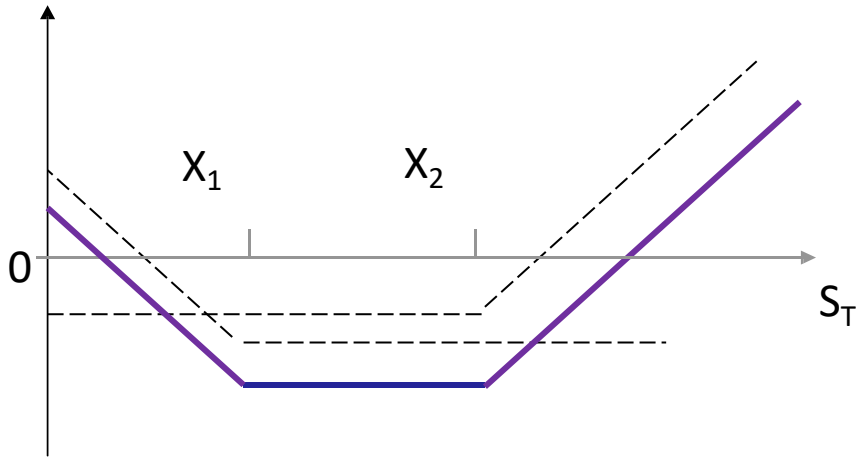
- It is constructed by long one call and long one put at the same strike price with the same expiration.



Combination Strategy

Strangle (c+p)

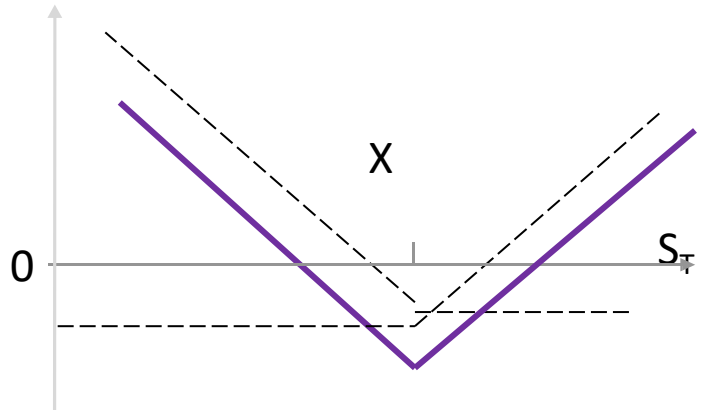
- It is constructed by long one call and long one put with the same expiration but different strike price.
- It is also call bottom vertical strategy.



Combination Strategy

Strip (c+2p)

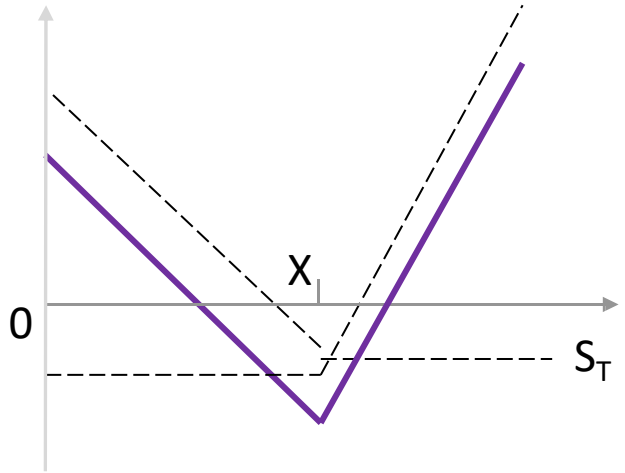
- It is constructed by long two puts and long one call with the same strike price and expiration.



Combination Strategy

Strap (2c+p)

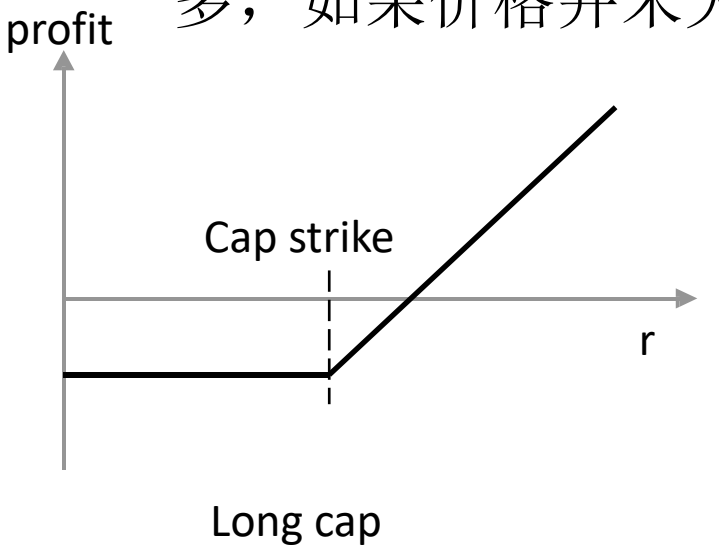
- It is constructed by long one puts and long two call with the same strike price and expiration.



Combination Strategy

Interest rate cap

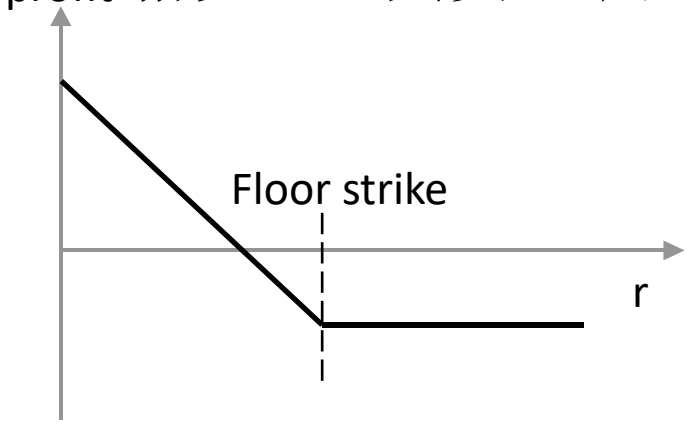
- A **long cap** is equivalent to a portfolio of long put options on fixed- income security prices.
  - ✓ Long cap可以分解为一系列针对债券价格的put option，债券价格下跌导致行权，跌越惨（收益率越高）赚越多，如果价格并未大跌（即利率较低）可能无法行权。



Combination Strategy

Interest rate floor

- A **long floor** is equivalent to a portfolio of long call options on fixed-income security prices.
  - ✓ Long floor可以分解为一系列针对债券价格的call option，如果利率下降导致债券价格上升时则行权，以固定价格买入，其实也就是利率越低价格越高时越赚钱。



Long floor

CONTENTS

Session 5

Exotic Options

Exotic options

- **Packages** (一揽子组合期权)
- Nonstandard option
  - ✓ **Bermuda option**: early exercise may be restricted to certain dates.
  - ✓ Early exercise may be somehow restricted means **initial lockout period**.
  - ✓ **Strike price may change** during the life of an option: the later, the higher.

Exotic Options

Exotic options (Cont.)

- **Gap option** (缺口期权): X_1 is the real exercise (price to buy or sell), X_2 is the trigger price.
- **Forward start options** (远期生效期权): options that being their existence at some time in the future.
- **Compound options** (复合期权): options of options
- **Chooser options** (任选期权): could be call OR put
- **Barrier options** (障碍期权)
  - ✓ Knock-out options本来可用但触及障碍会失效
  - ✓ Knock-in options本来无效但触及障碍后生效

Exotic Options

Exotic options (Cont.)

- **Binary options** (两值期权)
  - ✓ Cash-or-nothing call
    - The value of a cash-or-nothing call is $Q\,\mathrm{e}^{-rT}\,N\,(d_2)$
  - ✓ Asset-or-nothing call
    - The value of a asset-or-nothing call is $S_0\mathrm{e}^{-qT}N(d_1)$
  - ✓ A regular European call option is equivalent to a long position in an asset-or-nothing call and a short position in a cash-or-nothing call where the cash payoff in the cash-or-nothing call equals the strike price.

$$c = S_0\mathrm{e}^{-qT}N(d_1) - K\mathrm{e}^{-rT}N(d_2)$$

Exotic Options

Exotic options (Cont.)

- **Lookback options** (回望期权): payoffs that depend on the extreme values of underlying asset.
  - ✓ For fixed lookback call option: $V=\max(0, S_{MAX} - X)$
  - ✓ For floating lookback call option: $V= \max(0, S_T - S_{MIN})$
  - ✓ For fixed lookback put option: $V=\max(0, X - S_{MIN})$
  - ✓ For floating lookback put option: $V= \max(0, S_{MAX} - S_T)$
- **Shout options** (喊叫期权): payoffs depend on the larger one between intrinsic value of shout point and the usual payoff of European option

Exotic Options

Exotic options (Cont.)

- **Asian options** (亚式期权): payoffs that depend on the average value of the underlying spot price.
- **Exchange options** (交换期权): options to exchange one asset for another
- **Basket options** (篮子期权): options to purchase or sell baskets of securities.
- **Rainbow options** (彩虹期权): options exposed to two or more sources of uncertainty.
- **Volatility and variance swaps** (波动率互换)

Exotic Options

Hedging exotic option

- **Dynamic option replication** requires frequent adjustments, so it is costly.
- **Static option replication** may be used to construct once, it is cheaper.

CONTENTS

Session 6

Functions of Exchange

Functions of Exchange

- Product standardization
- Trading venue
- Reporting services

Clearing

Clearing

- **Clearing** is the term that describes the reconciling and resolving of contracts between counterparties.
  - ✓ **Direct clearing** refers to a bilateral reconciliation of commitments.
  - ✓ **Clearing rings** ask for participants in the ring, who had to be willing to accept substitutes for their original counterparties.
  - ✓ **Complete clearing** needs a clearinghouse which becomes counterparty to all transactions.

Risk Mitigation in OTC Markets

Risk mitigation in OTC markets

- **Special purpose vehicles (SPVs)**
  - ✓ A legal entity created typically to isolate a firm from financial risk. It transforms counterparty risk into legal risk. The obvious legal risk is that of consolidation(合并报表).
- **Derivatives product companies (DPCs)**
  - ✓ Generally it is a triple-A rated entity set up by one or more banks as a bankruptcy-remote subsidiary of a major dealer. The reality is that DPC is inextricably link with their parents, so it becomes an obsolete mechanism.

Risk Mitigation in OTC Markets

Risk mitigation in OTC markets (Cont.)

- **Monolines**
  - ✓ They are financial guarantee companies with strong credit ratings, which provide CDS of large companies.
- **Credit derivative product companies (CDPCs)**
  - ✓ CDPCs were an extension of the DPC concept that had business models similar to those of monolines.

CONTENTS

Session 6

17 Exchanges, OTC derivatives, DPCs and SPVs

18 Basic Principles of Central Clearing

19 Risks Caused by CCPs

Mechanics of CCPs

- Clearing and settlement
- Auctions
- Margining
- Novation and netting
- Loss mutualization

Advantages of Central Clearing in OTC Derivatives

Advantages

- Transparency
- Offsetting
- Loss mutualisation
- Legal and operational efficiency
- Liquidity
- Default management

Disadvantages of Central Clearing in OTC Derivatives

Disadvantages

- Moral hazard
- Adverse selection
- Bifurcations(分岔)
- Procyclicality(亲周期性)

Margin Requirements

Margin

- Initial margin: it covers the worst-case close out costs.
- Variation margin: it covers the net change in market value.

CONTENTS

Session 6

Risks Faced by CCPs

Default Risks

- Default or distress of other clearing members
- Failed auctions (会员破产，无人拯救即采用摊派法则)
- Resignations (会员辞职)
- Reputational (交易所名誉受损)

Risks Faced by CCPs

Non-default

- Fraud risk
- Operational risk
- Legal risk
- Investment risk (投资失误风险)
- Model risk
- Liquidity risk
- Settlement and payment risk
- Foreign currency (FX) risk

Risks Faced by CCPs

Non-default (Cont.)

- Custody risk
- Sovereign risk
- Concentration risk
- Wrong-way risk

Risks for Clearing Members and Non-members

Risks for members and non-members

- Risks of CCP failure through initial margins
- Risks of distress of CCP may result in:
  - ✓ Loss of default fund contribution
  - ✓ Potential additional exposure arising
  - ✓ Variation margin gains haircutting
- Risk for non-members is the exposure from CCPs, clearing members and other non-members.

Lesson from CCP Failures

Too big to fall: big banks and other financial instruments

Five key lessons

- Operational risk must be controlled as much as possible.
- Variation margins should be recalculated often and collected quickly (i.e., multiple times a day).
- Initial margins and default funds must be posted sufficiently.
- CCPs must actively monitor positions and penalize concentration.
- Availability to external liquidity sources.

CONTENTS

Session 7

Corporate Bonds

Fundamental of corporate bonds

- Indenture: 债券条款
- Maturity date: 债券到期日
- Types of corporate bonds: fixed, floating and zero-coupon
- Embedded option bonds: convertible, callable, and putable
  - ✓ Value of a callable bond = value of an option-free bond – value of the call.
  - ✓ Value of a putable bond = value of an option-free bond + value of the put.

Corporate Bonds

Corporate bonds type

- **Mortgage bonds**: backed by real estate holdings and/or real property
- **Collateral trust bonds**: backed by financial asset
- **Equipment trust certificates**: backed by the purchased assets, usually cash-producing assets
- **Debenture bonds**: backed by the general creditworthiness
  - ✓ Senior debentures are safer than junior debentures
- **Guaranteed bonds**: backed by a third party's guarantee

Corporate Bonds

Retired before maturity

- **Call provisions**: benefit issuer
- **Sinking-fund provisions**: benefit investors
- **Maintenance and replacement funds**: benefit investors
- **Redemption through the sale of assets and other means**
  - ✓ Release-of-property and substitution-of-property
- **Tender offers**: usually using a fixed spread

Corporate Bonds

Risks

- **Credit risk**: default risk and credit spread risk
- **Event risk**: adverse consequences from possible events
  - ✓ **Businessman's risk**: bonds with BBB or BB rating
- **High-yield bonds**: bonds below investment rating
  - ✓ Original issuers
  - ✓ Fallen angels
  - ✓ Restructurings and leveraged buyouts
  - ✓ Reset bonds
  - ✓ Deferred-coupon structures

Corporate Bonds

Default and recovery

- Issuer default rate发行人违约率
- Dollar default rate发行金额违约率
- Recovery rate违约后可追回率

CONTENTS

Session 7

Residential Mortgage

Mortgage

- Loan
  - ✓ Prime (A-grade) loans, subprime (B-grade) loans and alternative-A loans.
- Three reasons to prepay earlier: selling house, refinancing at lower rates, and partial prepayment
- **Agency (or conforming) MBS**: backed by government loans (GNMA) or by conventional loans (FNMA and FHLMC).
- **Label MBS**: backed by other loans

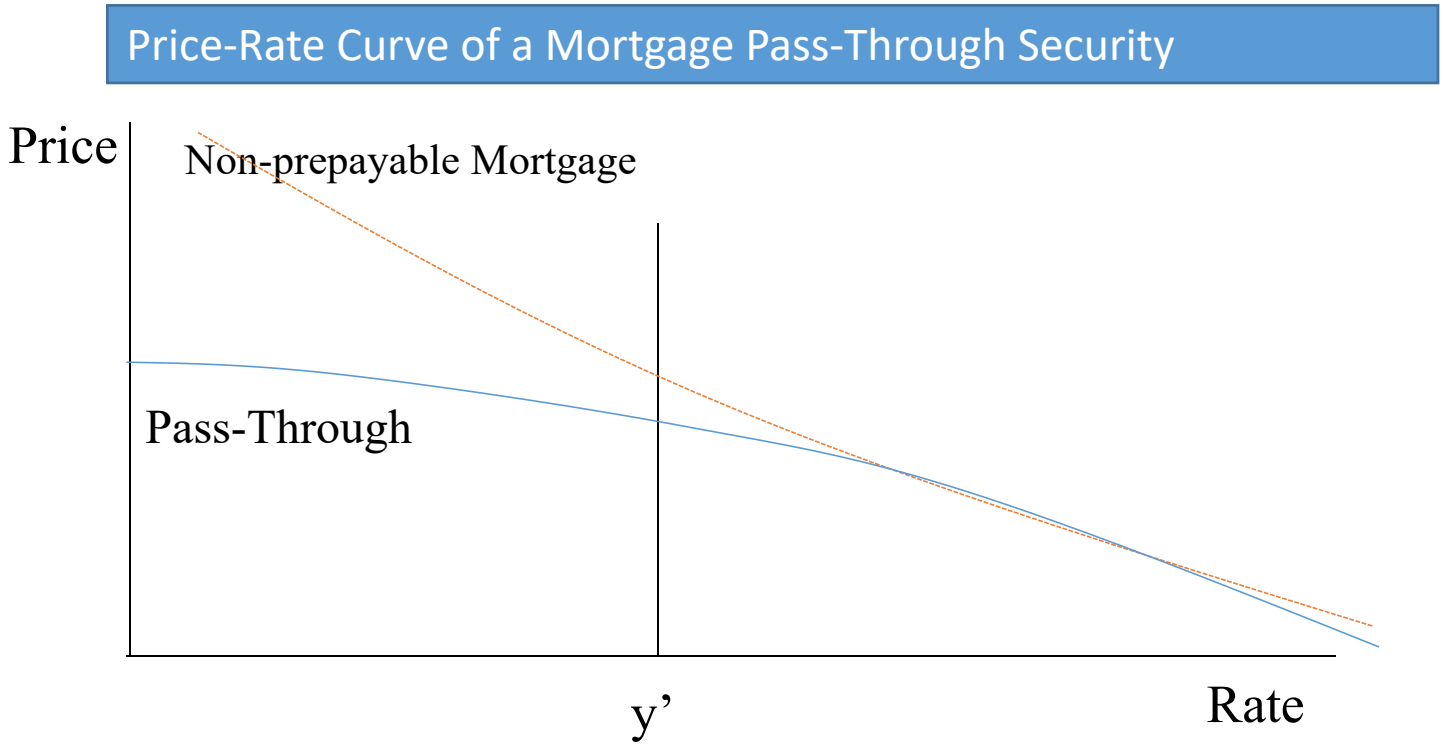
Residential Mortgage

Main factors that affect prepayments

- **Prevailing mortgage rates** (当前的利率水平)
  - ✓ Spread between the current mortgage rate and the original mortgage rate.
  - ✓ Path of mortgage rates
  - ✓ Level of mortgage rates
- **Characteristics of the underlying mortgage loans** (抵押贷款的本身特点)
- **Seasonal factors** (季节因素)
- **General economic activity** (一般经济因素)

Mortgage Pass-through Security

Price-rate curve of a mortgage pass-through security



Trading Pass-through Security

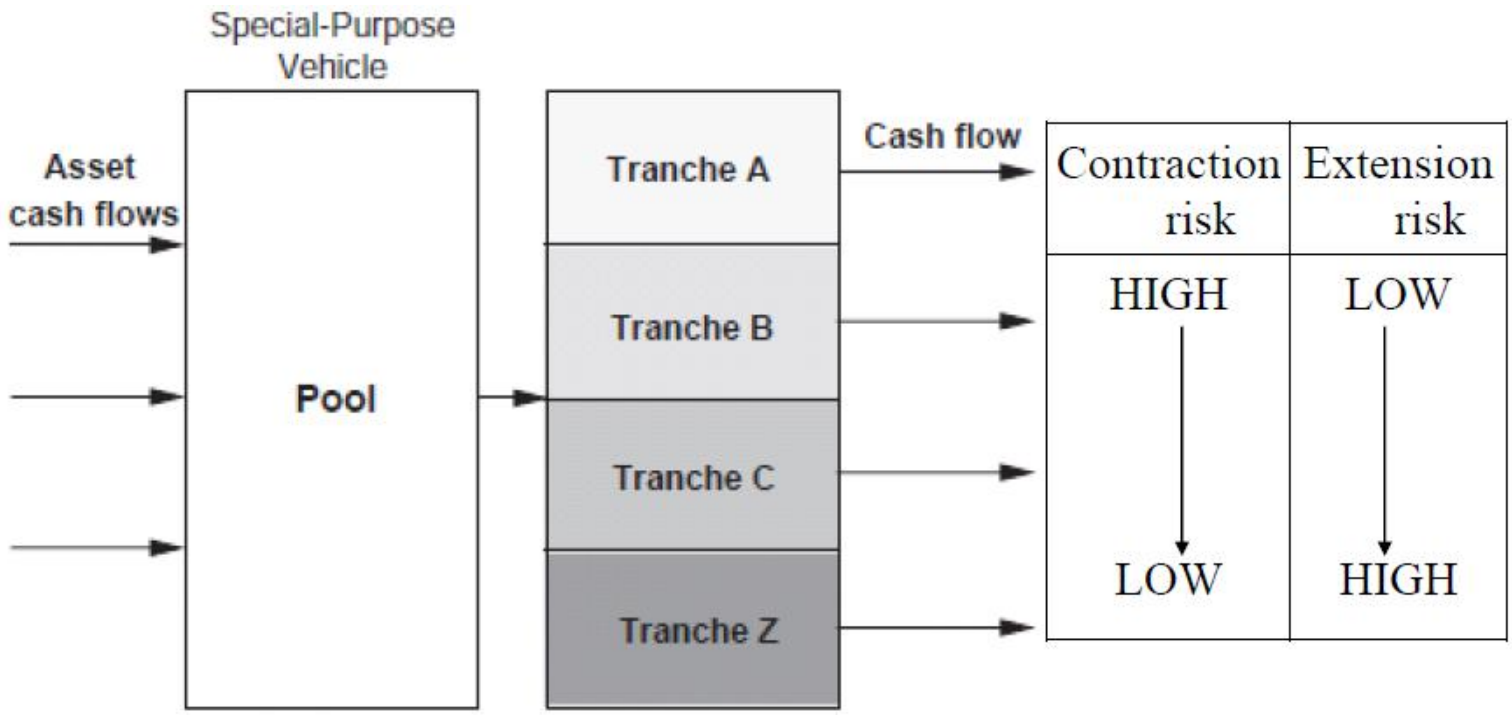
Fixed rate pass-through securities trade have 2 ways:

- **Specified pools**: The specified pools market identifies the number and balances of the pools prior to a trade.
- **To Be Announced (TBA)**: The TBA market, which is more liquid than specified pools, involves identifying the security and establishing the price in a forward market.
  - ✓ The pool allocation process whereby the actual pools are not revealed to the seller until immediately before settlement.

Mortgage Pay-through Security

CMO: sequential pay

Collateralized Mortgage Obligations, CMO



Tranching

Principal pay down window

Mortgage Pay-through Security

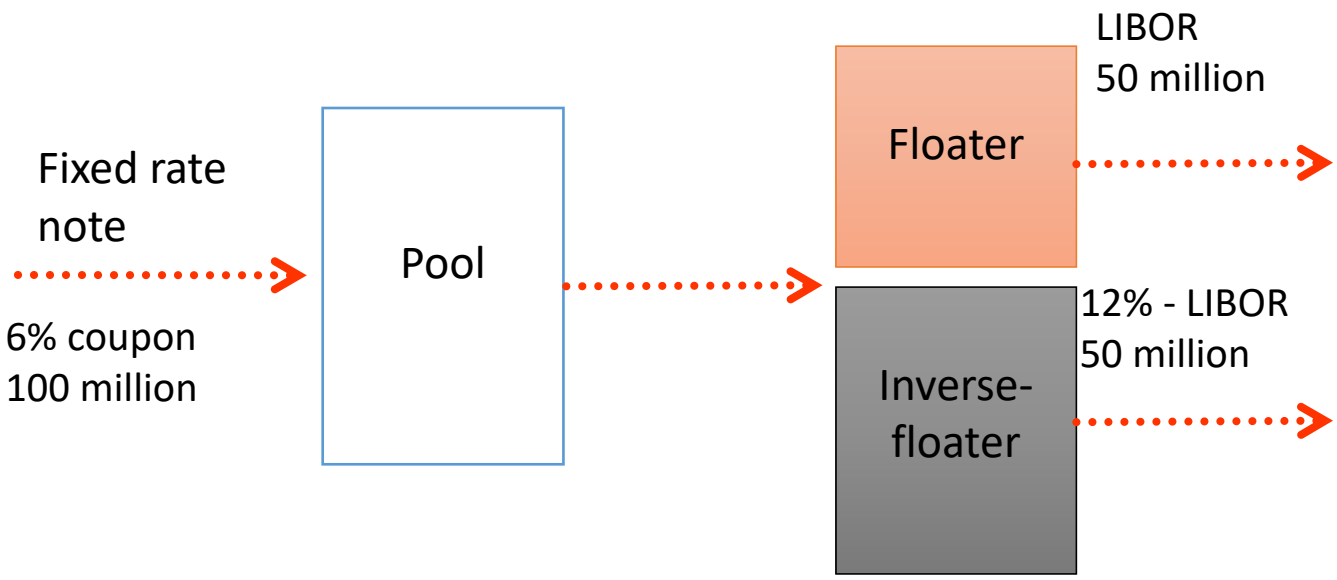
CMO: planned amortization class tranches, PAC

- The most common type of CMO today is the planned amortization class (PAC).

Tranche		Prepayment risk
PAC Tranches	A	LOW ↓ HIGH
	B	
	C	
Support tranche (may lead to broken or busted PAC)		

Mortgage Pay-through Security

Inverse floaters

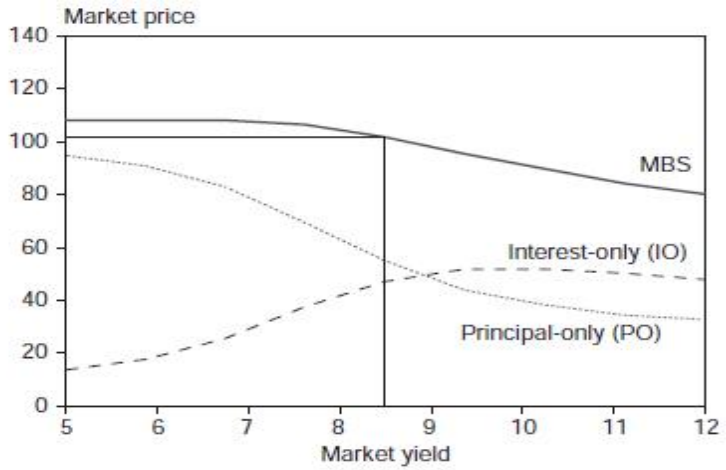


COUPON :100×6% = 6 = 50×(LIBOR) + 50×(12% - LIBOR)

PO and IO Characters

PO and IO Characters

- The underlying MBS exhibits significant negative convexity.
- The PO exhibits some negative convexity at low rates.
- The IO price is positively related to market rate at low current rates, so it have negative duration.
- The PO and IO prices are more volatile than the underlying.



Creating an IO and PO from an MBS

Prepayment

Measuring prepayment speeds

- Single monthly mortality rate (SMM) 月度提前还款率
- Conditional prepayment rate (CPR) 年化提前还款率
  - ✓ $(1 - CPR) = (1 - SMM)^{12}$
- The **PSA prepayment benchmark** assumes that the monthly prepayment rate for a mortgage pool increases as it ages.
- The PSA standard benchmark is referred to as 100 PSA (100% of benchmark).

Z-Spread and OAS

Z-spread and OAS

- **Zero-volatility spread** (z-spread) is a spread measure that an investor realizes over the entire T-rate curve, assuming the mortgage security is held to maturity.
- **Option-adjusted spread** (OAS) is defined as the spread, K, that, when added to all the spot rates of all the interest rate paths, will make the average present value of the paths equal to the market price.
- Callable bonds: Z spread > OAS
- Putable bonds: Z spread < OAS

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