FRM Notebook 3

- 期货投资入门
  - http://futures.hexun.com/help/default.html
- 现货 –》远期-》期货
  - 现货卖商品，期货卖合约
  - 期货目的：规避风险、价格发现
  - 期货场所：必须在交易所内
  - 期货商品范围有限制
  - 期货结算：每日无负债
- 期货与远期
  - 交易对象
    - 期货交易标准化合约
    - 远期交易实物商品
  - 功能作用
    - 期货交易能发现价格
    - 远期交易中的合同缺乏流动性，无发现价格。
  - 履约方式
    - 期货交易有实物交割和对冲平仓两种履约方式
    - 远期交易最终的履约方式是实物交收。
  - 信用风险
    - 期货交易实行每日无负债结算制度，信用风险很小
    - 远期交易从交易达成到最终实物交割有很长一段时间，此间市场会发生各种变化，任何不利于履约的行为都可能出现，信用风险很大。
  - 保证金制度
    - 期货交易有特定的保证金制度
    - 远期交易是否收取或收多少保证金由交易双方私下商定。
- 期货与证券
  - 基本职能
    - 证券市场的基本职能是资源配置和风险定价。
    - 期货市场的基本职能是规避风险和价格发现。
  - 交易目的
    - 证券：获取利息、股息等收入和资本利得。
    - 期货：规避现货市场价格风险或获取投机利润。
  - 市场结构
    - 证券：分为一级市场（发行市场）和二级市场（流通市场）
    - 期货：不区分一级市场和二级市场。
  - 保证金
    - 证券：一般采用现货交易方式，须交纳全额资金。
    - 期货：只需缴纳期货合约价值一定比例的保证金。
- 期货特点
  - 合约标准化
    - 期货合约标准化指的是除价格外，期货合约的所有条款都是预先由期货交易所规定好的

- 交易集中化
  - 交易所内。期货交易所实行会员制，只有会员方能进场交易。
  - 那些处在场外的广大客户只能委托期货经纪公司代理交易。
- 双向交易和对冲机制
- 杠杆机制
  - 一般为成交合约价值的 5%-10%的保证金，就能完成数倍乃至数十倍的合约交易
- 每日无负债结算制度

- 期货发展
  - 商品期货：农产品、金属期货、能源期货
  - 金融期货：利率、汇率、股票指数
  - 期货期权
    - 期货交易主要是为现货商提供套期保值的渠道
    - 期权交易不仅对现货商具有规避风险的作用，而且对期货商的期货交易也具有一定程度的规避风险的作用。相当于买了一份保险
- 期货市场
  - 期货交易所（场所、标准化）
  - 期货结算所（结算、担保、监督交割）
  - 期货经纪公司
    - 组织结构亦不尽相同，但一般包括财务部、客户服务部、交易部、结算部、现货交割部、研发部、行政管理部等部门。
  - 期货交易者（保值者、投机者、套利者）
  - 期货监管机构
    - 中国证监会期货监管部
  - 期货行业自律机构
    - 期货行业协会是依法成立的期货行业自律性组织，其会员由期货行业的从业机构和个人组成。
    - “政府-协会-交易所”三级管理体系
- 期货投资者
  - 投机：
    - 长线、短线（当天）、逐小利者
  - 套期保值
    - 买入(卖出)与现货市场数量相当、但交易方向相反的期货合约。
    - 买入套期保值是指通过期货市场买入期货合约以防止因现货价格上涨而遭受损失的行为
    - 卖出套期保值则指通过期货市场卖出期货合约以防止因现货价格下跌而造成损失的行为。
  - 套利
    - 指同时买进和卖出两张不同种类的期货合约。交易者买进自认为是“便宜的”合约，同时卖出那些“高价的”合约，从两合约价格间的变动关系中获利。
    - 套利一般可分为三类：跨期套利、跨市套利和跨商品套利。
    - 跨期套利

- 交易中最普遍的一种，是利用同一商品但**不同交割月份**之间正常价格差距出现异常变化时进行对冲而获利的，又可分为牛市套利(bull spread)和熊市套利(bear spread 两种形式。例如在进行金属牛市套利时，交易所买入近期交割月份的金属合约，同时卖出远期交割月份的金属合约，希望近期合约价格上涨幅度大于远期合约价格的上帐幅度；而熊市套利则相反，即卖出近期交割月份合约，买入远期交割月份合约，并期望远期合约价格下跌幅度小于近期合约的价格下跌幅度。
    - 跨市套利是在**不同交易**所之间的套利交易行为。当同一期货商品合约在两个或更多的交易所进行交易时，由于区域间的地理差别，各商品合约间存在一定的价差关系
    - 跨商品套利指的是利用两种不同的、但**相关联商品**之间的价差进行交易。这两种商品之间具有相互替代性或受同一供求因素制约。跨商品套利的交易形式是同时买进和卖出相同交割月份但**不同种类的商品期货合约**。
- 期货交易所
    - 郑州商品交易所（ZCE） 1990
        - 批准交易的品种有小麦、棉花、白糖、绿豆等期货品种
    - 上海期货交易所（SHFE）
        - 有铜、铝、天然橡胶、燃料油等四个品种的标准合约。
    - 大连商品交易所（DCE） 1993
        - 中国最大的农产品期货交易所。
        - 正式挂牌交易的品种是玉米、黄大豆 1 号、黄大豆 2 号、豆粕和豆油
    - 中国金融期货交易所（CFFEX） 2006
        - 极筹划推出股票指数期货、期权，并深入研究开发国债、外汇期货及期权等金融衍生产品
- 期货
    - 金融期货
        - 利率、汇率、股指
    - 商品期货
        - 农产品、金属、能源(原油)
    - 期货期权
- 交易风险
    - 资金风险管理（头寸限制制度）
    - 涨跌停板制
    - 强制平仓制
    - 持仓限额制度（超过限额，规定强行平仓或提高保证金比例）
    - 大户报告制度（头寸持仓限量 80%以上）
    - 实物交割制度
- 结算风险
    - 保证金制度（合约总值的 5-10%）
    - 每日结算制度（每日无负债制度、逐日盯市制度）

        - 低于**维护保证金**水平，交易所就通知该会员在限期内缴纳追加保证金，以达到**初始保证金**水平，否则，就不能参加下一交易日的交易。
- 期权
    - 买方、卖方、权利金、敲定价格、通知和到期日等。
- 差价期权（Spreads）交易策略是指持有相同类型的两个或多个期权头寸
    - 牛市差价期权（Bull spreads）- 赚收益
        - **买入低价看涨**、卖出高价看涨
        - 买入低价看跌、卖出高价看跌 – 一开始得到权利金
        - 看跌收益 《 看涨收益
    - 熊市差价期权（Bear spreads）- 赚费用
        - 购买的期权的执行价格高于所卖出的期权的执行价格。
        - 买入高价看涨、卖出低价看跌（期权费高）
        - 买入高价看跌、卖出低价看跌 （期权费高）
    - 蝶式差价期权（Butterfly Spreads）
        - 购买一个较低执行价格 X1 的看涨期权
        - 购买一个较高执行价格 X3 的看涨期权
        - 出售两个执行价格 X2 的看涨期权，其中 X2 为 X1 与 X3 的中间值。
        - 一牛市+一熊市
        - X2 非常接近股票的现价。该投资策略的损益如下图所示。如果股票价格股票价格保持在 X2 附近，运用该策略就会获利。
- 牛市、熊市和日历差价期权都可通过购买一个看涨期权同时出售另一个看涨期权来构造。
    - 在牛市和熊市差价期权两种情况下，两个看涨期权的执行价格不同而到期日相同。
    - 在日历差价期权情况下，两个看涨期权的**执行价格相同而到期日不同**。
    - 而一个对角线差价期权中，两个看涨期权的执行价格和到期日都不相同。
    - 对角线差价期权有许多不同的种类。损益状态通常随相应的牛市或熊市差价期权损益状态的变化而变化。
    - 组合期权是一种期权交易策略，该期权策略中包括同一种股票的看涨期权和看跌期权。我们将讨论所谓的跨式期权、strips 期权、straps 期权和宽跨式期权。
        - 跨式期权（Straddle）策略
            - 同时买入具有相同执行价格、相同到期日的、同种股票的看涨期权和看跌期权
            - 当投资者预期股票价格会有重大变动，但不知其变动方向时。则可应用跨式期权策略。
- 新型期权（exotic options）
    - 场外交易
    - 打包期权（packages）是由标准欧式看涨期权、标准欧式看跌期权、远期合约、现金及标的资产本身构成的组合。
    - 非标准美式期权

        - 而实际中，交易的美式期权不一定总是具有这些标准特征。有一种非标准美式期权称为 Bermudan 期权。在这种期权中提前行使只限于期权有效期内特定日期。例如美式互期期权就只能在指定日才能行使。
    - 远期开始期权
        - 远期开始期权是现在支付期权费但在未来某时刻开始的期权，它们有时用来对雇员实施奖励。通常选择合适的期权条款以便该期权在启动时刻处于平价状态。
    - 复合期权
        - 复合期权是期权的期权。复合期权主要有四种类型：看涨期权的看涨期权，看涨期权的看跌期权，看跌期权的看涨期权，看跌期权的看跌期权。复合期权有两个执行价格和两个到期日。
    - 任选期权
        - 任选期权（as you like it）具有如下的特征：即经过一段指定时期后，持有人能选择期权或者是看涨期权或者是看跌期权。
- 词汇
    - 头寸
        - 是一种市场约定，既未进行对冲处理的买或卖期货合约数量。对买进者，称处于多头头寸；对卖出者，称处于空头头寸。
    - 期货贴水与期货升水
        - 在某一特定地点和特定时间内，某一特定商品的期货价格高于现货价格称为期货升水；期货价格低于现货价格称为期货贴水。
    - 正向市场
        - 在正常情况下，期货价格高于现货价格。
    - 反向市场
        - 在特殊情况下，期货价格低于现货价格。
    - 开仓
        - 指期货交易者买入或者卖出期货合约的行为。
    - 平仓
        - 是指期货交易者买入或者卖出与其所持期货合约的品种、数量及交割月份相同但交易方向相反的期货合约，了结期货交易的行为
    - 持仓
        - 交易者手中持有合约称为持仓。
    - 斩仓
        - 在交易中，所持头寸与价格走势相反，为防止亏损过多而采取的平仓措施。
    - 最小变动价位
        - 指期货合约的单位价格涨跌变动的最小值。
    - 持仓量
        - 是指期货交易者所持有的未平仓合约的数量。
    - 持仓限额
        - 是指期货交易所对期货交易者的持仓量规定的最高数额。
    - 当日结算价

        - 是指某一期货合约当日成交价格按照成交量的加权平均价。当日无成交价格的,以上一交易日的结算价作为当日结算价。
    - 成交价格
        - 交易所计算机自动撮合系统将买卖申报指令以价格优先、时间优先的原则进行排序
    - 开盘集合竞价
        - 在某品种某月份合约每一交易日开市前 5 分钟内进行，其中前 4 分钟为期货合约买、卖指令申报时间，后 1 分钟为集合竞价撮合时间。

Banks

- Banks
    - Commercial banks (take deposits and make loans)
        - Retail banks: serve individuals and small businesses
        - Wholesale banks: corporate and institutional customers
    - Investment banks
        - Raise capital for their customers (issuance of debt and equity securities)
        - Advise them on finance matters such as mergers and restructurings
- Major risks
    - Credit risk
        - Borrowers may default
        - Counterparties to contracts such as derivatives may default on their obligations
    - Market risk
        - Risk of losses from a bank's trading activities
    - Operational risk
        - Arise from external events or failures of internal controls
    - Regulators
        - Banks hold adequate capital against these risks
        - Credit and operational within one year
        - Market risk with a shorter time horizon
- Economic capital vs regulatory capital
    - Equity capital
        - Percentage of assets
    - Regulatory capital
        - The amount determined by bank regulators
        - Equity - tier 1 capital
        - Subordinated long-term debt 次级长期债务– tier 2 capital
    - Economic capital
        - The amount that a bank believes is adequate
- Deposit insurance and moral hazard
    - Deposit insurance
        - A depositor's funds are guaranteed up to some maximum amount
        - Funded by insurance premiums paid by banks

    - Moral hazard
        - Banks take greater risks than they would normally take
        - Offer higher interest rate and make higher-risk loans
    - Mitigation
        - Insurance premiums risk-based
        - Poorly-capitalized pay more than well-capitalized
- Investment banks financing arrangement
    - Private placement, public offering, best efforts, firm commitment
    - Arranges a securities issuance
    - private placement 私募
        - securities are sold to investors with substantial wealth.
        - Earn fee income
    - Public offering
        - Sold to the investing public at large
    - Firm commitment
        - Bank purchase the entire issue at a negotiated price
        - Earn income by selling the issue at a **spread** above the paid price
    - Best offers
        - Distribute an issue on a best efforts basis
        - Not purchase the whole issue, not buy the unsold portion.
    - Initial public offerings (IPO)
        - First time issues of stock by firms
        - Bank can assist in determining the price by analysing value
        - Price discovery: Dutch auction process
            - Start higher, reduce until a bidder agrees to pay it.
            - Each buyer specifies the price and #units
            - Continue until all are sold
            - The price at which the last of the shares can be sold
    - Potential conflicts of interest
        - Press financial analysts to maintain "buy" recommendation
        - Press financial advisors to allocate these stocks and bonds to accounts
        - Material non-public information
            - Negotiate a loan or arrange a securities issuance.
            - Trading desk may benefit unfairly
    - Glass-Steagall Act
        - Separate commercial banking, security services, and investment banking units
        - **Chinese Walls**: prevent information from being shared
- Banking Book vs trading book
    - Revenue and income from its fee-based activities using accrual accounting
    - Other rules apply to its lending and trading activities
- Banking book (make loans and keep them as assets)
    - **Loans** made, primary assets of commercial bank
    - Balance sheet: principle amount to be paid and accrued interest on the loan
    - Nonperforming loan: no value does not include accrued interest
        - More than 90 days overdue

    - Loan loss: borrower will not fully **replay** the principal
    - loan loss reserve: earning manipulation
- Trading book
    - assets and liabilities related to trading activities
    - marked to **market** daily.
        - Liquid market: use prices
    - Marked to model
        - Illiquid market: use complex or custom instruments estimate price
- Originate-to-distribute model
    - Model: Make loans and sell them.
    - Mortgage lenders do this
    - Government agencies purchase mortgage loans from banks and issue securities backed by the cash flows from the mortgages
    - Benefits
        - Increase liquidity in the lending market
            - Residential mortgage, student loans, credit card balances, commercial loans/mortgages
        - Banks free up capital they can meet regulatory requirements or make new loans
    - Drawback
        - Led banks to loosen lending standards

Insurance Companies and Pension Plans

- protect policyholders from specific loss events in exchange for the payment of periodic premiums
- Life Insurance
    - Long-term
    - Pay to beneficiaries upon natural death and accidental death
    - **Term** (temporary) life insurance: a specified amount for a fixed period of time
    - **Whole** (permanent) life insurance
    - **Liability insurance** is subject to long-tail risk
- Property and Casualty (P&C) insurance
    - Annual and renewable
    - Property: fire and theft
        - Geographical 地理学 Seismographical 地震学 meteorological 气象学
    - Casualty
        - Third-party liability for injuries
- Health Insurance
    - Medical service
    - Group health insurance
- Risk facing Insurance Companies
    - Insufficient funds to satisfy policyholder's claims
        - Sudden surge of payouts in a short time
    - Poor return on investments
        - Fixed-income securities if defaults sudden increase
    - Liquidity risk

    - Credit risk
        - When transacting with banks or reinsurance companies
    - Operational risk
- Mortality tables
    - **Compute insurance breakeven**
- P&C Insurance Ratios
    - Loss ratio
        - Payouts versus premiums. 60-80%.
    - Expense ratio
        - Expense versus premiums, 25-30%
        - Loss adjustments (claims investigation and accessing payout amounts)
        - Selling (broker commissions)
    - Combined ratio
        - Loss ratio + expense ratio
    - Combined ratio after dividends
        - Combined ratio + payment of dividends
    - Operating ratio
        - (Combined ratio (after dividends) – investment income) / premium
- Moral hazards and adverse selection
    - Moral hazards
        - Risk: having risk lead to policyholder to act more recklessly
        - Health insurance: request more services than necessary.
    - Mitigate
        - Deductible (for a fixed amount)
        - Coinsurance provisions (pay a fixed percentage, less than 100%)
        - Policy limits (fixed maximum payout)
    - Adverse selection 逆向选择
        - Unable to differentiate between a good and a bad risk
        - Greater initial due diligence
            - Physical examination
            - Driving records
        - Ongoing due diligence
- Mortality risk vs longevity risk
    - Mortality (死亡数，死亡率; 必死性，必死的命运) risk
        - Die earlier than expected due to illness or disease
    - Longevity risk
        - Live longer than expected
    - Hedging
        - Longevity: good for life insurance and bad for annuity products
        - Mortality: good for annuity and bad for life insurance
        - Reinsurance contracts
            - Pay to another insurance company
        - Longevity derivatives
            - Hedge longevity In annuity contracts
            - Longevity bond (or survivor bond)
- Capital Requirements
    - Life insurance

        - Assets: investment (80%), other assets (20%)
        - Liabilities and Equity:
            - Policy reserves (85%)保险单责任准备金
            - Subordinated long-term debt (5%)
            - Equity capital (10%) 主权资本、权益资金、权益资本
                - Equity capital represents contributed capital plus retained earnings and serves as a protection barrier if payouts are larger than loss reserves.
    - P&C
        - Assets: investment (80%), other assets (20%)
            - Highly liquid bonds with shorter maturities
        - Liabilities and Equity:
            - Policy reserves (50%)
            - Unearned premium: 10%
            - Subordinated long-term debt (5%)
            - **Equity capital (35%)**
                - Highly unpredictable nature of claims
                - Both timing and amount
- Guaranty System
    - Insurance: state level, bank: federal level
    - Insolvent (破产的; 无力偿付债务的)
    - an annual limit may apply w.r.t. to the contribution
    - transfer to another life insurance
- Pension Funds
    - Defined benefit plans 养老金固定收益计划(
        - Employee benefit **known**, employer contribution unknown
        - State the amount that employee will receive upon retirement.
        - Has risk borne by employer
        - Features
            - Indexation of pensions amounts to account for inflation
            - Continued pension payment to surviving spouse upon death
            - A lump sum payment upon death
        - One pooled account for all employees
    - Defined contribution plans 养老金固定缴款计划
        - Employee benefit unknown, employer contribution known
        - Both employer and employee contributions being invested options by the **employee**
        - Upon retirement, opt to receive a lifetime pension in the form of an annuity or a lump sum.
        - No risk borne by employer, investment performance borne by employee
        - One account associated with one employee

Mutual Funds and Hedge Funds

- Open-end (most common)
    - Redeem from fund company

    - Money market, bond (fixed-income), equity (solely in stock), hybrid
    - Money market – risk averse
        - Treasury bills, commercial paper, bank's Acceptance Bill（BA 银行承兑汇票）
    - Bond
        - Sovereign debt 债务, corporate bonds, asset-backed securities
    - Trade at fund's **net asset value** (NAV)
        - (assets – liabilities)/outstanding shares
    - tax
        - dividend, capital gain
    - fee
        - management fee (salary) 1% most common, 2.5-3% internal
        - advertising surcharge (recommends investment) 0-1% around 0.25%
        - sales charge load
            - front-end load: charge at the beginning
            - back-end load: charge when leave within a certain window
- Closed-end
    - Invest areas: In **specific** emerging markets not diversified emerging market
    - Shares remain static instead of dynamic.
    - Can only trade not redeem.
    - Trade at a price other than NAV, usually at a discount or a premium to actual NAV
- Exchange-Traded Funds (ETF)
    - An innovative twist on the open-end mutual fund
    - Exchange-traded: trade like closed-end fund, can place stop/limit order/short selling
        - Different: trade at NAV. Most are passively managed index funds
        - Disclose their holdings twice each day
        - Lower internal expense fee
- SEC (securities and exchange commission)
    - They are subject to regulatory oversight
    - Prospectus
- NAV
    - NAV = (fund assets – fund liabilities) / total shares outstanding
    - Open: After the close of trading day
    - Closed/etf: calculated continuously throughout the day
- Hedge vs mutual
    - Commingle (掺和)
    - Investor
        - Mutual: market to any and all investors
        - Hedge: wealthy and sophisticated investors, institutional
    - Disclosure & regulatory
        - Hedge: less
    - Leverage
        - Hedge can use leverage and both long & short strategies
    - Redeem
        - Not required to redeem any time

        - Advance notification and lock-up periods for any withdraw requests
    - 不良债权(Distressed Debt)
- Hedge fund expected return and fee structure
    - Incentive fee
        - 2 plus 20%, flat 2% of all assets and 20% of all profits above benchmark
        - lucrative （获利多的，赚钱的）
    - soften incentive fee with a few safeguards
        - hurdle rate (门槛收益率)
            - benchmark must be beaten before incentive fees can be charged
        - high-water mark clause(高水位线条款)
            - the previous losses must be recouped and hurdle rate surpassed before incentive fee can apply
            - 基金净值超过历史最高值后才能收取相应的绩效费(通常为20%)
        - clawback clause （追回条款、回拨条款）
            - retain a portion of previously paid incentive fees, offset losses should they occur
- hedge fund strategies
    - long/short equity
    - Dedicated Short 空头策略
    - Distressed Securities 不良资产
        - BB or less are considered to be “junk” bonds
        - CCC rating are considered to be “distressed.”
    - Merger Arbitrage
        - Cash deal or stock deal
    - Convertible Arbitrage

Introduction (Options, Futures, and Other Derivatives)

- Derivative
    - Whose value is derived from another security. The underlying asset.
- Market maker
- Contract
    - Spot contract: buy or sell today
    - Forward contract
        - The price and quantity of an asset to be delivered on or before a future-specified date.
    - Future contract: legally binding agreement to buy or sell a commodity or financial instrument in a designed month at a previously upon price
- Option (buy/sell, expiration, price)
    - Call/put: right to buy/sell a specified number of shares at the given strike price, on or before the expiration date.
    - Expiration date
        - American option: on or before
        - European Option: on the actual date

    - Position
        - Long: owning the security
        - Short: sells a security he does not own
    - Strike price
        - The price at which the security may be bought or sold.
    - price
        - Bid price: quoted bid, highest price
        - Offer price: offered for sale, minimal price
        - Bid-ask spread: ask – bid price
- Derivative Market - exchange
    - Open outcry system (CBOT): signals and shouting
    - Electronic trading system
- Over-the-counter (OTC)
    - Larger than exchange
    - Pros: Flexibility, recorded
    - Cons: more credit risk
- Option vs forward vs future
    - Option: right but not obligation
    - Forward: no standardization, traded in the OTC
        - Foreign exchange
    - Future: formalized, legally, standardized, traded on an exchange
        - Quality, quantify, delivery time, location, price
        - Has an initial/margin investment
        - Symmetrical payout
- Call option payoff
    - Call
        - Strike price: X
        - Stock price at maturity: S_T
        - Call premium: C_0
        - Buyer
            - Payoff: C_T = max(0, S_T - X), or max(0, S_t - X)
            - Profit: C_T – C_0
        - Seller/writer
            - Payoff: -C_T
            - Profit: C_0 – C_T
    - Put
        - Buyer
            - Payoff: P_T = max(0, X – S_T)
            - Profit: P_T – P_0
        - Seller/writer
            - Payoff: -P_T
            - Profit: P_0 – P_T
- Forward contract payoff
    - Payoff
        - Spot price at maturity: S_T
        - Delivery price: K
        - Long: S_T – K

        - Short: K – S_T
- Category of trades
    - Hedger
        - Forward: fix the price
        - Option: insurance policy
    - Speculators
        - Take long and profit from this position
        - Effectively betting on future price movement
        - Use futures: a large possible gain or loss
    - Arbitrageurs
        - Take offsetting positions in order to lock in a riskless profit
- Hedging strategies 对冲 risk management
    - Reduce or eliminate financial exposure
    - Long position
        - Enter a short future contract
        - Buy a put option
    - Short position
        - A long future contract
        - A call option
- Speculative 杠杠 risk-taking
    - Make bet on the market
    - Limited amount creates significant **leverage**
    - Future: payoffs are symmetrical. Initial margin.
    - Options: asymmetrical gains. Gain can be huge and losses are limited.
- Arbitrage opportunities 套利
    - Risk-free profit in excess of risk-free rate via discovery & manipulation of mispriced securities.
    - Use equivalent offsetting positions in one or more markets.
    - Do not last long as supply & demand forces will adjust prices to eliminate the arbitrage situation.
- Risk form derivatives
    - A trader wants to hedge may speculate, operational risk
    - Risk limits should be set and monitored.

Futures Markets and Central Counterparties

- Position
    - Long: purchase of a future contract
    - Short: seller of a future contract
- Category
    - Speculator: gain exposure to changes in the price
    - Hedger: use contract to reduce exposure to price changes
- Open interest
    - The total number of long positions in a contract.
    - Equal to total number of sellers.
- Clearinghouse
    - The seller and buyer do not know each other
    - The clearinghouse takes the opposite side of every transaction

- Compare
  - Forward
    - Private, customized contracts
  - Future
    - Organized exchange, highly standardized
- Elements
  - Quality
    - Easy for financial asset, difficult for Commodity
  - Contract size
    - Quantity
  - Delivery location
  - Delivery time
    - By month
  - Price quotation and tick size
    - How the price will be quoted
    - the minimum price fluctuation (tick size)
  - daily price limits
    - maximum price movement during a day.
    - Limit up/limit down
  - Position limits
    - The maximum number of contacts that a speculator may hold.
    - Does not apply to hedgers.
- Convergence of future and spot prices
  - Basis= spot price – futures price
- Margin requirements
  - Margin
    - cash or highly liquid collateral placed to ensure any trading losses will be met.
  - Initial margin
    - The amount required to open a futures position
  - Maintenance margin
    - The minimum margin account balance required to retain the future position.
  - Margin call
    - Margin balance below the maintenance margin, investor gets a margin call. He needs to bring the account to initial margin
  - Variation margin
    - The amount necessary to do this
- Clearinghouse
  - No counterparty default
  - Clearing margin, liquid enough to honor all obligations under future contracts
- OTC
  - **Central counterparties** (CCP) – similar to clearinghouse
    - Post initial margin and any variation margins on a daily basis
    - Any loss is settled in cash at the end of the trading day.
  - Pros
    - Collateralized positions with reverse and margins

        - Reduction of financial system credit risk
        - Increased transparency of OTC traders
    - Historically - Bilateral clearing – every party
        - A master agreement with a credit support annex (CSA)
        - Providing collateral
        - Loss is settled in cash at the end of the trading day.
- Counterparty risk exposures
    - No netting: double-edge graph
    - Bilateral netting: single way graph
    - Multilateral netting: connected to CCP
- Future market quotes
    - Maturity, trading price,
    - settlement price: the price right before the end of the previous trading day
    - volume: the number of contracts
    - volume >= open interest (the total number of longs positions)
    - normal futures market
        - increasing settlement price over time
    - inverted futures market
        - decreasing settlement price over time
- The delivery process
    - Delivery
        - Short: deliver the good. Long: pay
        - Notice of intention to deliver
    - Cash-settlement contract
        - Settlement price
    - Reverse or offsetting, trade
        - Long can buy a short
    - Exchange for physicals
        - Find an opposite trader, off the floor of the exchange
- Types of orders
    - Market order
        - Buy/sell a the best price available
        - Discretionary order
            - A broker can delay transaction in search for a better price.
    - Limit orders
        - Limit buy below the current price
        - limit sell above the current price
        - have a time limit
    - stop-loss orders
        - prevent losses or protect profits
        - stop loss sell: if price below a threshold, combined with a long to protect profit
        - stop loss buy: combined with a short to reduce loss
    - stop-limit orders
        - a stop and a limit order
        - once a stop price is reached, it will turn into a limit order
    - market-if-touched

        - orders become market orders once a specified price is reached
    - time-of-day order
        - the time period
    - good-till-canceled (GTC)/open orders
        - remain open until either transact or are canceled
    - fill-or-kill orders
        - must be executed immediately or the trade will not take place
- Forward and future contracts
    - Forward
        - Private, customizable, bilateral, not regulated, difficult to offset,
        - Settle at expiration
    - Futures
        - Currencies, bonds, stock indices, physical commodities
        - More regulated, more liquid
        - Marked to market and settle daily.

Hedging Strategies Using Futures

- Hedging with futures
    - Short hedge
        - Have a long position and expect prices to decline
    - Long hedge
        - Have a short position and expect prices to rise
- Pros. and Cons.
    - Farmer use future, short hedge, locks a future selling price
    - Buy corn, anticipatory/long hedge, locks in a future purchasing price.
- Cons
    - Less profitability
    - Questionable benefit that accrues to shareholders: they can hedge themselves
    - Company hedge risk:
- Basis Risk
    - No perfect hedge – **basis risk**
        - **Asset** in positions is not the same as the underlying the futures
        - The horizon may not match perfectly with the **maturity**.
    - Basis = spot price of asset being hedged – futures price of contract used in hedge
    - Basis risk
        - The change in basis over the hedge horizon is basis risk
    - Minimize
        - Contract most highly correlated with the spot position
        - Contract maturity is close
        - Liquidity must be considered
- Sources
    - Interruption in the **convergence** of the futures and spot prices
    - Change in the cost of carry
        - Cost: storage, safekeeping, **interest**, insurance, related costs
    - Imperfect **matching** between the cash and hedge asset

        - Maturity or Duration mismatch
        - Liquidity mismatch
        - Credit risk mismatch
            - Widening or narrowing of credit spreads
- Optimal hedge ratio
    - The degree of correlation between the rates
    - Hedge ratio
        - Futures positions / spot positions
    - Optimal hedge ratio (minimizes variance of the combined positions)
        - HR = rau(S,F) sigma_S / sigma_F
        - rau(S,F) = COV(S,F) / sigma_S / sigma_F => HR=COV(S,F)/sigma_F^2 = Beta(S,F)
    - R^2
        - Linear: change in spot price -> change in future price
        - Beta = hedge ratio
- Hedging with stock index futures
    - Hedge equity portfolios using futures contracts on stock indices
    - Number of contracts
        - Beta_portfolio * (portfolio value / value of futures contract)
        - Beta_portfolio * (portfolio value / (futures price * contract multiplier))
- Tailing the hedge
    - Over-hedge. Can use tailing the hedge.
    - Multiple the hedge ratio by the daily spot price / futures price ratio.
- Adjusting the Portfolio Beta
    - Portfolio value: P
    - Underlying asset: A (the stock index futures contract)
    - Portfolio beta: beta
    - Target beta: beta*
    - Number of contracts= (beta* - beta) P/A
        - Negative: sell future (decreasing systematic risk)
        - Positive: buy future (increase systematic risk)
- Rolling the hedge forward
    - Hedge a long relative to **maturity** of futures
    - Rollover risk
        - Exposed to basis risk of original future
        - And the new positions each time the hedge is rolled forward

Interest Rates

- Types of rates
    - Treasury rate – risk free
    - LIBOR (London interbank offered rate)
    - Repo rates
        - Sell price -> repurchase price => implied rate
        - Overnight repurchase agreement
        - Longer-term agreements are called term repos
    - Short-term risk free
        - Treasury rate too low, use LIBOR for short-term

- Compounding
  - FV1 = A(1+R/m)^(m*n) – compounding
  - FV2 = A e^(R*n) – continuously compounding
  - Continuous rate
    - **R_c = m * ln(1+R/m) – find the continuous**
    - R: = m (e^(R_c/m)-1) – find the annualized
- Spot rates and bond pricing
  - Spot rate = zero-coupon bond yields
    - Discount rates for a single cash flow
- Bond pricing
  - Coupon bond: a series of cash flow (each is a zero-coupon bond)
  - Assume continuous compounding, semi-annual coupons
  - B = c/2 \sum_{i=1toN} exp(-z_j/2*j) + FV exp(-z_n * N/2)
    - c: annual coupon
    - N: # semiannual payment periods
    - FV: face value
    - Z_j: bond equivalent spot rate at j periods (j/2 years)
- Bond yield
  - Single discount rate = present value to its market price
  - Par yield: rate price = par value
- Bootstrapping spot rates
  - Treat each t-bond as a zero-coupon bonds
  - Compute z_1 rate for 6 month
  - Compute z_2 based on z_1
- Forward rates
  - exp(- r_2 / m *t_2) = exp(- r_1 / m * t1) * exp(-r / m * (t2-t1))
  - r2*t2 = r1*t1 + r*(t2-t1)
  - r = (r2*t2 – r1*t1)/(t2-t1) = r2 + (r2-r1)*t1/(t2-t1)
- forward rate agreements FRA
  - cash flow if receiving R_K = L * (R_K - R) * (T_2 – T_1)
  - cash flow if paying R_K = L * (R - R_K) * (T_2 – T_1)
    - L: principal
    - R_K: **annualized** rate on L, expressed with compounding period T1 – T2
    - R: **annualized** rate, expressed with compounding period T1 –T2
    - T_i: time I, expressed in years
  - Value
    - Value (if receive R_K) = L *(R_K – R_forward) * (T2-T1)*exp(-R2*T2)
    - Value (if paying R_K) = L *(R_forward – R_K) * (T2-T1)*exp(-R2*T2)
    - R_forward: forward rate between T1 and T2
    - R_2 is continuously compounded rate
- Duration
  - Duration 平均剩余期限
    - = \sum_{i=1 to n } t_i * (c_i/B) * exp(- y * t_i)
    - B: bond price
    - 债券到期时间越长，久期就越大
    - 息票率、到期收益率越大，久期就越短。

        - 债券息票率（coupon rate）越高，久期越小
    - Change of yield curve \delta y is
        - Delta B / B = - duration * \delta y
        - 反向关系
    - Basis point: 0.01%, or 1%%
    - Modified duration
        - duration / (1 +y/m), m is the #compounding periods
        - 衡量的是债券的价格/收益率对于利率的敏感度（衡量利率风险）
    - Dollar duration: modified duration * price of the bond
    - 债券有两大风险，一是利率风险，二是信用风险。其中利率风险就是用久期来衡量的。学术点来说，久期就是用现金流作为权，计算的加权平均剩余期限。
    - 它只能反应利率曲线平移所带来的债券价值变化
    - 麦考雷久期
        - MacD = \sum_i t_i PV_i / PV, where PV=sum PV_i
    - 面值（face value），收益率(yield rate)，到期时间(maturity)，duration 本质上其实就是加强版的 maturity
    - 久期就是投资者购买一个债券后，把本金和利息全都收回的加权时间总和。
    - 一个债券，年息票率 coupon rate 为 10%，到期收益率 YTM 为 10%
    - 债券可以溢价发行，也可以折价发行，还可以平价发行
    - 从数学的角度上来说，你把债券价格（Bond price）的对数看成是一个关于收益率（Yield）的函数，然后久期（Duration）是泰勒展开式的第一阶系数，凸性（Convexity）是展开式的第二阶的系数。实际上是近似了债券价格关于收益率的 semi-elasticity（求中文翻译）。
- Convexity
    - Duration only for small change.
    - Widening error as yield swings grow. Degree of convexity
    - Convexity effect = ½ * convexity * \delta_y^2
    - Correcting errors embedded in duration
- Change
    - Percentage price change = duration effect + convexity effect
    - = - D * \delta_y + 0.5 * C * \delta_y^2
- Term structure
    - Expectation theory
        - Forward rates = expected future spot rates
    - Market segmentation theory
    - Liquidity preference theory

Determination of Forwards and Future Prices

- 远期和期货价格
    - 无风险利率不变时，相同。
    - 如果标的资产价格和利率正相关，那么期货价格 > 远期价格
        - 每日结算而立刻获利
    - 如果标的资产价格和利率负相关，那么期货价格 < 远期价格
        - 每日计算而立刻亏损

    - 幅度
        - 时间、税收、交易费用、保证金
- 定义
    - t：现在时间，单位为年
    - T：到期时间，单位为年
    - S：标的资产在 t 的价格
    - S_T：标的资产在 T 的价格
    - K：合约中 T 时的交割价格
    - f：合约中多头在 t 时刻的价值
    - F：t 时刻，合约的价格，期货价格或者远期价格
    - tt =T-t
- 定价
    - 平价原理 Spot-Forward/Futures Parity Theorem
    - 无收益 zero coupon （中途无收益）
        - f + K exp(-r*tt) = S, when f=0, F=K
        - F = S * exp(r*tt) 思想，将来值
    - 不同期限
        - F=S*exp(r*tt)
        - F'=S*exp(r' * tt')
        - F'= F exp(r' *tt' – r*t')
            - New r = (r' * **tt**' – r*t') / (t*'- t')
    - 有现金收益 I
        - f + K exp(-r*tt) = S-I, when f=0, F=K
        - F = (S-I) exp(r*tt)
        - I>0：资产如股票分红
        - I<0：黄金等 cost of carry
        - 组合 B：一份 I+K exp(-r t)的负债
    - 有收益率
        - f+K*exp(-r*tt) = S * exp(-q*tt) （单价*单位）
        - F= S*exp((r-q)*tt)
        - 组合 B：exp(-q*tt)单位的证券，收益率为 q，到期后为一单位
    - 外汇远期 – 收益率
        - S:一单位外汇对应的本币的价格
        - r: 国内利率，q：外汇国利率
        - F= S*exp((r-q)*tt)
    - 远期利率协议
- Cost of carry 持有成本
    - 持有成本=利息成本 r + 保存成本 u – 收益 q
- 模型
    - 成本模型 cost-of-carry (对可持有性资产 carryable assets)
        - 当前价格，持有一直到交割时的总成本
    - 预期模型 expectation model (非可持有性资产 non-carryable assets)
        - 不容易保存，或者不可以交割的
- 便利收益 convenience yield, z
    - F*exp(z *tt) = S * exp(c * tt)

    - F = S * exp((c-z) * tt)
    - 投资性： z=0，否则有套利
- 差别
    - 现价和期货价格的差异
        - 基差 basis = 现货价格- 期货价格
    - 期货价格与预期的差距
        - 期货价格 < 预期： 现货溢价(normal backwardation)
        - 期货价格 > 预期：期货溢价(contago)
- short sale, short squeeze
    - short must pay dividends
    - short must use collateral to guarantee the eventual repurchase of the security
- price
    - F_0 = S_0 * exp(r*T)
- Price with carrying cost
    - F_0 = (S_0 – I)* exp(r*T), I is the present value of the cash flow
- Effect of a known continuous dividend
    - F_0 = S_0 exp((r-q) * T)
- Value of a forward contact 价值
    - K: delivery price after inception at T 交割价
    - No cash flow: S_0 – K exp(-rT)
    - Carry cost: S_0 – I - K exp(-rT)
    - Continuous dividend: S_0 exp(-qT) - K exp(-rT)
- Currency
    - F: measured in domestic current (DC) per unit of foreign currency (FC)
    - F = S exp((DC-FC)*T)
- Forward vs future prices
    - Futures contracts is that daily **marking to market** 每日交割
- Commodity futures
    - Storage cost
        - F_0 = (S_0 + U) exp(rT)
        - F_0 = S_0 exp((r+u) T), u: continuous yield
    - Convenience yield y
        - F_0 = S_0 exp((r+u – y)T),
        - Y: benefit of owning spot consumption commodity
- Expectation
    - F_0 vs E(S_T)
    - F_0 < E(S_T): normal backwardation, positive systematic risk
    - F_0 > E(S_T): contango, negative systematic risk
- Backwardation 现货溢价
    - Future price < spot price, S_0 < F_0 <S_T
    - A benefit to hold the asset
- Contango 期货溢价
    - Future price > spot price
- 第三章 远期和期货价格.doc
    - http://doc.mbalib.com/view/173de6753471e849acc0d9b9d1e5a8ec.html

Interest Rate Futures

- accrued interest 应计利息
  - 应计利息是指自上一利息支付日至买卖结算日产生的利息收入，具体而言
  - 零息债券是指发行起息日至交割日所含利息金额
  - 附息债券是指本付息期起息日至交割日所含利息金额
  - 贴现债券没有票面利率，其应计利息额设为零。
- Day count convention
  - Accrued interest = coupon * # days from last coupon to settlement day / #days in coupon period
  - US treasury bond: actual / actual 每个月实际天数
  - US corporate and municipal bonds use 30/360
    - 每个月 30 天算
  - Us money market instruments (T-bill) use actual/360
- Quotations for T-bonds (Treasure bond 美国的长期国库)
  - T-bond prices are quoted relative to a 100 par amount in dollars and 32nds
    - 95-5 => 95 5/32=95.1562
  - **dirty/cash** price = quoted/clean price + accrued interest
- Quotations for T-bills (T-Bill 是美国政府发行的短期债务证券)
  - Discount rate ~= annualized yield
    - Bill with a $100 face value with n days to maturity and a cash price of Y
    - T-bill discount rate = (100-Y)/n*360
- T-bond future
  - Deliverable bond
  - CBOT (Chicago board of trade) use conversion factor
  - Cash received (by short position) = QFP * CF + AI
    - QFP: quoted **future** price (most recent settlement price)
    - CF: conversion factor
      - Computed daily
      - **(Discounted price – accrued interest)/face value**
    - AI: accrued interest
- CTD (cheapest-to-deliver bond)
  - Cost to purchase bond = quoted bond price + AI
  - CTD goal: quoted bond price – QFP*CF
  - Yield >6%, CTD have low-coupon, longer-maturity bond
  - Yield < 6%, CTD have high-coupon, shorter-maturity bond
  - Yield curve upward sloping, CTD bonds tend to longer maturities
  - Yield curve downward sloping, CTD tends to shorter maturities
- Price
  - Cash price = quoted price + AI (应计利息)
  - Future price = (Cash price – present value of interest)* exp(r * t)
  - Future price = quoted future price * conversion factor – accrued interest
- Eurodollar futures (3-month)

    - Eurodollar deposit (a eurodollar is a U.S. dollar deposited outside the United States)
    - Chicago Mercantile Exchange
    - Settles in cash and minimum price change is one tick (1 basis point), or 25 per 1 million contracts
    - Interest rate is 3-month (90-day) forward LIBOR.
    - Eurodollar futures are based on a Eurodollar deposit with a face value of 1M.
    - Z is the quoted price for a Eurodollar futures contract, the contract price
        - Eurodollar futures price = 10,000(100- 0.25*(100-Z))
- Convexity adjustment
    - The corresponding 90-day forward LIBOR (on an annual basis) for each contract is 100 —Z.
    - **Actual forward rate = forward rate implied by futures - ½*sig^2*T1*T2**
        - T1: the maturity on the futures contract
        - T2: the time to maturity of the rate underlying the contract (T1+90)
        - Sig: the annual std of the change in the rate underlying the futures contract, or 90-day LIBOR
    - LIBOR zero curve (spot rates)
        - R2 = (R_f*(T2-T1) + R1*T1) / T2
        - Given spot rate R1 and the length of each forward contract period, calculate the next spot rate R2.
- Duration-based hedging
    - Combined duration is 0. No change in value when yields change by a small amount
    - P * D_p + N * F* D_F=0 => N= - P * D_p / (F * D_F)
- Limitations of duration
    - Price/yield of a bond is convex. Duration-based are linear approximations.
    - Interest rates change are large and nonparallel (not perfectly correlated)

Swaps

- Two parties agreed to exchange interest payment based on a specified principal over a period of time.
- Plain vanilla interest swap: one if fixed and the other is floating.
    - Notional principal: no need to exchange principal (the same currency and the same amount)
    - Floating: LIBOR
- Swap similar to Futures
    - No payment by either party, custom instruments, not traded in any organized secondary market.
    - Unregulated, default risk, most participants are large institutions
- Financial intermediaries: banks, earn a spread of 3 to 4 basis
- Confirmations, ISDA, outline the details of each swap agreement.
- Comparative advantage
    - Absolute advantage: fixed and floating market
    - Comparative advantage: fixed difference > floating difference or vice versa
- The discount rate

    - The forward rate -> LIBOR spot curves
- Value an interest rate swap with bonds （考虑利息和本金）
    - The value of a floating rate bond
        - The notional amount at any of its periodic settlement dates when the next payment is set to the market (floating) rate.
        - Discount the next (known) floating-rate payment plus the notional amount at the current discount rate.
    - Fixed-rate bond
        - Spot rate curve
    - Value = B_fixed – B_floating
- Value an interest rate swap with FRA (只考虑利息)
    - Value
        - LIBOR spot rate -> forward rate (continuous)
        - Forward rate (continuous) -> forward rate (m periods)
            - R = m (e^(r/m)-1)
        - Use **forward rate** to predict cash flow
            - Cash = principal * r * t
        - Discount use spot rate
    - LIBOR is spot, use it to compute forward rate -> net cash flow
- Currency swaps
    - Exchange principal and interest in different currencies
    - The cash flow are not netted because they are in different currencies
    - A:
        - Lend USD to B
        - Borrow GBP from A
        - pay interest GBP regularly
        - Pay principal BGP back to B
    - B
        - Lend GBP to A
        - Borrow USD from A
        - pay USD interest regularly
        - Pay principal back to A
    - Value
        - V(USD) = B_USD – S_0 * B_GBP
        - S_0: spot rate in USF per GBP
    - Value using FRA
        - Forward rate: S_0 exp(DC - FC)
        - USD cash flow
        - BGP cash flow -> forward rate -> BGP value in USD (cash * rate)
        - Net cash flow = USD – GBP_USD
        - Discount net cash flow
- Using a Currency Swap to Transform Existing Positions
    - Comparative advantage
- Swap credit risk
    - V_A + V_B = 0
    - More likelihood of default
- Other types of swaps

- Equity swap: return on stock in exchange fixed-rate or floating-rate payment.
- swaption: an option which gives the holder the right to enter into an interest rate swap.
- Commodity swap: pay a fixed rate for the multi-period delivery of a commodity or receive a floating rate based on the average spot rate at the time of delivery.
- Volatility swap:
- Accrual swaps
- Cancellable swaps
- Index amortizing rate swaps
- Constant maturity swaps
- Exotic swaps:

Mechanics of Options Markets

- American: anytime before
- European: on the date
- Call options
  - Owner/buyer/long
  - Writer/seller/short
  - Payoff $C_T = Max(0, S_T - X)$
  - Profit $p = C_T – C_0$ (premium)
- Put options
- Underlying Assets
  - Stock
    - Typically exchange-traded, American-style options.
    - One option contract is 100 shares
    - Adjust for stock splits but not cash dividends
  - Currency
    - Buy or sell an amount of **foreign** currency based on a **domestic** currency.
    - Most of are traded over-the-counter, the rest exchange traded
  - Index
    - Typically, European-style options and are cash settled.
    - Both OTC and exchange.
  - Futures
    - American-style, exchange-traded
    - The price is the future price
- Stock options Specifications
  - Expiration
    - American/European
    - LEAPS (long-term equity anticipation securities) more than one year, have January expirations.
  - Strick Prices
  - Option class: all options of the same type
  - Option series: an option class with the same expiration.
  - Out of money/at the money/in the money
  - Intrinsic value: maximum (0, |S-X|)

    - The time value: intrinsic value – option premium
- Nonstandard Products
    - FLEX
        - Exchange-traded on equity
        - Goal: compete with nonstandard options that trade OTC
        - Minimum 100 contracts
    - ETF
        - Similar to index options, but American-style and delivery of shares
    - Weekly options
        - Short-term options
    - Binary options
        - Pay a fixed one price ($100) if S_T >X or 0
    - CEBOs
        - A form of credit default swap
        - Payoff is triggered if the reference entity suffers a qualifying credit events prior to expiration date.
        - European options, cash settled
    - DOOM
        - **Put options**, only in the money in the event of a large downward price movement in the underlying asset.
        - Strike price is quite low.
- Effect of dividends and stock splits
    - In general not adjusted for cash dividends, included into price.
    - Adjust for split
        - 2-for-1 stock split, strike price reduced by one-half and #shares double
        - b-for a stock split, strike price a/b, #shares b/a
    - stock dividends
        - if pays 25% stock dividend, same with 5-for-4
- Position and exercise limits
    - Options: #options can have for a stock.
    - Exercise: #options can be exercised over any five consecutive business days
- Option trading
    - Option quote: price of one stock, One contract 100 shared, cost=quote*100
    - Market maker
        - Profit from bid-offer spread and provide liquidity
        - Floor broker: a particular firm and execute trades for the public
        - Offsetting trade: when a buy(short) option is offset within a sale(purchase) of the same option. Otherwise, open interest increases by one.
    - Commissions
        - Cost
            - Trade size, broker type (discount or full service)
            - Fixed amount + percentage of the trade amount
        - Bid-offer spread
            - Additional Cost = cost * 0.5
            - Ask: 12, offer: 12.2, then cost for each side = (12.2-12)*0.5

- Margin Requirements
  - Options with maturities <=9 moths cannot use leverage
  - Longer, max borrow 0.25%* option value
  - Writing options (sellers) must have a margin account due to high potential losses and default, depends on the amount and position.
  - **Naked option** (uncovered option)
    - The writer does not own a position in the underlying asset.
    - Initial margin and maintenance margin
      - Option premium + percentage of underlying share price
- Option clearing corporation (OCC)
  - Exchange-traded have no default risk.
  - All trades are cleared by one of its clearing members.
  - Meet net capital requirements and help finance emergency fund in the event of default.
  - Broker -> contract clearing member
- Exercising an option
  - Must sell or buy the underlying asset on the **third** business day after the order to exercise is received.
  - Results open interest -1
  - At contract expiration, unexercised options will be exercised by brokers
- Option-like securities
  - Warrants
    - Issued by a company to make bond more attractive
    - Similar to call option, upon exercise, company receives strike price and may issue new shares to deliver.
  - Employee stock options
    - When it is exercised, #shares outstanding increase
  - Convertible bonds
    - Gives bondholder the option of exchanging the bond for #shares common stock.

Properties of Stock Options

- Factors
  - S_0: current stock price
  - X: strike price
  - T: time to expiration
  - r: short-term risk-free rate over T
  - D: present value of the dividend
  - Sigma: expected volatility of stock prices
- Current price
  - Call: S increase, value increase max(0, S - X)
  - Put: S increase, value decrease max(0, X-S)
- Strike price
  - Call: X increase, value decrease
  - Put: X increase, value increase
- Time to expiration
  - American-style: T increase, value increase

- European-style: cannot be true ?
- Risk-free rate
  - Call: r increase, value increase
  - Put: r increase, value decrease
- Dividends
  - Call: D increase, value decrease
  - Put: D increase, value decrease
- Volatility
  - Put: sigma increase, value increase
- Upper and lower bounds
  - Define
    - c/c: value of a European call/put
    - C/P: value of an American call/put option
  - Upper bounds
    - C<=S_0 and c<=S_0 # call less than stock price c=max(0,S-X)<=S
    - P<=X, p<=X # put less than strike price p=max(0,X-S) <=X
    - European put: p <=X exp(-rT)
  - Lower bounds European call on a non-dividend paying stocks
    - Portfolio P1: one European call, X, at T +
      - Zero-coupon risk-free bond pay X at T
    - Portfolio P2: one share of stock
    - P1 >= P2
      - c + X exp(-rT) >=S_0
    - c >= max(0, S_0 – X exp(-rT))
  - European Puts on Nondividend-Paying Stocks
    - Portfolio P3: one European put p + one share of stock S
    - Portfolio P4: zero-coupon risk-free bond that pays X at T
    - p + S_0 >= X exp(-rT)
    - p >= max(0, X exp(-rT) – S_0)
- Call-Put Parity 欧洲期权
  - A combination fiduciary call + protective put.
  - Fiduciary call (use bond to buy stock)
    - Pure-discount, riskless bond pays X at maturity
    - And a call with exercise price X
    - Out of money: X, in the money: X + (S-X) = S
  - Protective put (sell stock)
    - One share of stock S + put option with exercise X
    - Out of money: S, in the money: (X-S) + S=X
  - c + X exp(-rT) = S + p
    - European-style, the same exercise price
    - c – p = S – X exp(-rT)
  - S = c-p+X exp(-rT)
    - A long call c
    - A short put p
    - A long position in risk-free discount bond
- Limits
  - European call, max(0, S_0 – X exp(-rT)) <= c <= S_0

    - American call, max(0, S_0 – X exp(-rT)) <= C <= S_0
    - European put, max(0, X exp(-rT) - S_0) <= p <= X exp(-rT)
    - American put, max(0, X- S_0) <= P <= X
        - Can be exercised earlier
- Inequality 美式期权
    - S – X = C – P <= S – X exp(-rT) 可以提前执行
- Impact of dividends on option pricing (S_0 -> S_0 - D)
    - Portfolios
        - P6: European call option, c, plus cash equal to D + X exp(-rT)
        - P7: one share of underlying stock S
    - Call (replace S_0 -> S_0 - D)
        - c >= S_0 – D – X exp(-rT)
    - put (replace S_0 -> S_0 - D)
        - P >= D + X exp(-rT) – S_0
- Impact of dividends for American calls and put-call parity
    - put-call parity
        - p + S_0 - D = c + X exp(-rT)
    - American
        - S_0 – X – D <= C – P<= S_0 – X exp(-rT) (**可以提早执行**)

Trading Strategy involving options

- Protective puts
    - Portfolio （卖自己的股票）低价止损，看涨
        - A long position in underlying stock S
        - A long position in put option P_0
    - Looks like a call option.
    - S decrease, loss is the premium (最低损失)
- Covered call
    - Portfolio （卖）看跌 （赚期权价格）
        - Sell a call option on a stock that's owned by the writer
    - S increase, payoff is the premium （最高收益）
- Bull and Bear Spreads
- Bull call spread
    - Portfolio 低买高卖，期望价格高
        - Long A call option with exercise price X_L
        - Short a call option with higher exercise price X_H 赚期权费
    - Break even 零收益
        - X_L + C_L – C_H (买入 call 付出了 C_L，得到了 C_H)
    - Max profit
        - X_H – X_L + C_H – C_L
- Bear call spread 看跌
    - Portfolio
        - Long a call with higher exercise price X_H
        - Sell the call with lower exercise price X_L
    - Portfolio 价格下降，都被执行
        - Sell a put with low X_L

        - Buy a put with high X_H
        - When price drop, both options are exercised X_H-X_L + net premium
    - The opposite of bull call
- Puts can be used to replicate the payoffs, bear put spread
    - Buy A put with higher exercise price
    - Sell a put with lower exercise price
- Butterfly spreads
    - Portfolio (three calls) 股价在中间
        - Buy one call with a low exercise price
        - Buy another call with a higher exercise price
        - Sell **two** calls with an exercise price in between
- Calendar spreads
    - Two options with the same strike price but different expirations
    - Use put options
        - Sell short-dated option
        - Buy long –dated option
    - Profit if stock remains in a narrow range, but losses are limited
    - Losses are not asymmetric as they are in the butterfly spread.
    - types
        - Neutral calendar spread – close to the current stock price
        - Bullish calendar spread – above the stock price
        - Bearish calendar spread – below the stock price
    - Reversed calendar spread
        - Buy a short-dated option
        - Sell a long-dated option
- Diagonal spreads
    - Different strike price and different expirations
- Box spreads
    - A bull call spread and a bear put spread on the same asset
    - A constant payoff = high exercise price – low exercise price
    - Present value of pay off = net premium paid (profit =0)
- Combination Strategies
    - Straddle 多头跨式期权交易 编辑
        - A long straddle 同样的行权价格
            - Buy a call and a put at the same strike price and expiration
            - Bets on volatility.
            - make profits by Higher or lower
            - symmetric around strike price
        - a short straddle
    - Strangle
        - A long strangle 不同的行权价格
            - Buy a call and a long different strike prices and expiration
            - Cheaper to implement
        - A flat section between strike prices
    - Strips and straps
        - Strips 同样的行权价格，多一份 put

        - Two puts and one call same strike price and expiration.
        - Price down
    - Straps 同样的行权价格，多一份 call
        - Two calls and one put
        - Bullish
- Collar
    - A combination of protective put and covered put
    - Owner of the asset buy a protective put, then sell a call to pay for the put. If the premiums are equal, it is a zero-cost collar.
- Interest rate caps
    - An agreement in which one party agrees to pay the other at regularly intervals over a certain period of time when the benchmark interest rate exceeds the strike rate specified in the contract.
    - Strike rate = cap rate
    - A cap is a portfolio of call options on LIBOR called **caplets**
- Interest rate floor
    - Floor rate,
    - A portfolio of put options on LIBOR called floorlets.
- Options on rate and prices
    - LIBOR call
        - Interest rate increase, bond price decrease
    - Bond price call
        - Interest rate decrease, bond price increase
- Interest rate collar
    - A simultaneous position in a floor and a cap on the same benchmark rate over the same period with the same settlement dates.
- Purchase a cap and sell a floor
    - Buy a cap at 8%, sell a floor at 4%, the borrowing cost stay within 4%-8%
- Purchase a floor and sell a cap
    - Purchase a floor at 3% and sell a cap at 7%
    - The return within 3% - 7%

Exotic Options

- Question
    - Payoff structure, credit risk
    - What's the cost?
    - A pricing model needed?
    - How to reverse it? The cost?
- Reason
    - A unique hedge for a firm's assets
    - Tax and regulatory concerns
- Package
    - Some combination of European options, forwards, cash and underlying assets
    - Examples: bull, bear, calendar spreads, straddles, strangles
    - Often contain a long position and a short position, the initial cost is 0
- American options -> nonstandard options

    - Restrict early exercise to certain dates 行权时间
        - At the end of each month: Bermudan option
    - Early exercise limited to certain partition of the life 行权时间
        - Lock out period: 6-month option, first three month lock out
    - Strike price may change 行权价格可变
        - 3-year call, 40 initial, may rise to 44 in year 2 and 48 in year 3
- gap option
    - two prices, X1 and X2. X2 is the trigger price.
    - X2 是触发价格，X1 行权价格
    - Gap call option
        - X2 > X1, if S>X2, pay off = S – X1, else payoff=0
        - If X2<X1, payoff S-X1 can be negative, will be reduced to X2-X1
    - Gap put option
        - X2 < X1, if S<X2, pay off = X1- S. else payoff=0
        - If X2 > X1, negative, pay off is X1 – X2
- Forward start options
    - Begin existence at some time in the future
    - Employee incentive plans
- Compound options – options on options
    - A call on a call
        - Buy a call option at a set price for a set period of time
    - A call on a put
    - A put on a call
    - A put on a put
    - two levels of underlying
- chooser options
    - after some time, choose whether a put or call option.
- Barrier options
    - Payoff depends whether the asset price reaches a certain barrier level over the lift of the option.
    - Less expensive, knock-in, knock-out
    - Down-and-out call (put)
        - Price hit the barrier level (less than current stock price), cease to exist
    - Down-and-in call (put)
        - Price hit the barrier level (less than current stock price), comes into existence
    - Up-and-out call (put)
        - Price hits barrier level (> stock price), cease to exist
    - Up-and-in call(put)
    - Volatility maybe negative for a barrier option, down-and-out, up-and-out
    - Down-and-out call + down-and-in call = standard call
    - Up-and-out put + up-and-in put = Standard put
- Binary option
    - Pay a fixed amount at expiration
    - **Cash-or-nothing** call, Q is paid if assets above the strike price
        - N(d_2) is the probability the price above strike price,
        - Value N(d_2)Qexp(-rT)

    - **Asset-nor-nothing** call, pays the value of the stock when the contract is initiated. S_0 exp(-qT) N(d_1), q is the continuous dividend yield.
- Lookback options 最小、最大
    - Payoff depends on the maximum or minimum asset price .
    - A floating lookback call
        - Expiration price – minimum price
    - A floating lookback put
        - Maximum price – expiration price
    - A fixed lookback call
        - Maximum price - Expiration price
    - A fixed lookback put
        - Expiration price – minimum price
- Shout options 自定义
    - Pick a date when he “shouts” to the option seller
    - Shout call
        - S < strike price, payoff = shout out price – S
        - Stock price rise, payoff = standard call = strike price - S
- Asian options 平均
    - Average price call/put
        - Based on average price, payoff = strike price – **average stock price**
        - Less volatility, Price lower < standard option
    - Average strike call/put
        - Payoff = **average price** – stock price
    - If average if geometric, a price model is ok, lognormal.
    - Most use arithmetic average
- Exchange options
    - Option to exchange one asset for another, exchange one currency with another.
- Basket options
    - Purchase or sell baskets of securities.
    - Any exotic options that involve different assets are referred to as rainbow options
- Volatility and Variance swaps
    - A **volatility swap**: exchange of volatility based on a notional principal.
    - One pay based on pre-specified volatility, the other based on realized volatility.
    - Variance swaps: variance rate = volatility^2
        - Easier to price and hedge
- Issues in hedge exotic options
    - Option Greeks to measure sensitivity of the option value.
        - Asian options, uncertainly gets smaller
    - Hedge positions in barrier and other is not straightforward.
    - **Dynami**c options replication
        - Frequent trading, costly to implement
    - Static option replication
        - A short portfolio of options that approximates the option
        - Created once

Commodity Forwards and Futures

- Lease rate, carry markets, storage cost, convenience yield
- Commodity forward vs financial forward
- Expected spot price <- supply and demand
- Forward curve/strip: different expire day
- Forward pricing
    - F_(0,T): forward price at time 0 and delivery at time T
    - S_t: spot price at time t
    - Portofolio
        - Long forward F_0T
        - A long bond pay F_0T at T
    - Payoff: forward contact S_T – F_0T, bond: F_0T
    - Final: S_T = a long position in the commodity
    - Risk-adjusted discount rate alpha
        - E(S_T) exp(-aT) = F_0T exp(-rT)
        - F_0T = E(S_T) exp- (r - a)T
    - NPV
        - NPV = E(S_T) exp(-aT) – S_0
        - Set NPV=0
        - F_0T = S_0 exp(rT)
- Storage cost
    - F = S_0 exp(r + gamma) T
- **Cash-and-carry arbitrage 期货 F_过高，卖期货**
    - Begin
        - Borrow money at the market interest rate 借钱
        - Buy the commodity at S_0 买商品
        - Sell a future contract at the current futures price 卖期货
    - expire
        - deliver the commodity and receive the future price 收钱
        - repay the loan plus interest 还钱
- **reverse cash-and-carry arbitrage 期货不值钱，买期货**
    - begin
        - sell commodity short S_0 借商品，卖商品
        - 借出钱 at interest rate
        - buy futures 买期货
    - expire
        - collect loan 收回贷款
        - buy commodity and cover short sale 买商品
- lease rate 租借商品的利率 = reverse cash-and-carry
    - the cost of borrowing the commodity
    - F = S_0 exp (r-delta) T , delta: lease rate
- Contago and backwardation
    - Contago: A upward-sloping forward curve 期货值钱
    - Backwardation: downward-sloping 期货不值钱
- Storage cost

    - F >= S_0 exp(rT) + FV(of storage cost)
    - F = S_0 exp(r+lambda) T
- Convenience yield
    - Only for carry market, when a commodity is stored
    - F >= S_0 exp(r+storage - convenience) T
    - Investor who does not earn a convenience yield
        - F<= S_0 exp(r+storage)T
    - Convenience yield = storage cost + lease rate 要么持有，要么租借出去
- Gold
    - Positive lease rate
    - Cost of production
- Corn
    - Production is seasonal, and demand is even throughout the year
    - Store cost is high, harvest small
- Electricity
    - Not storable.
    - Demand is not constant
    - Expected spot prices
- Natural gas – fall high
    - Constant production, seasonal demand
    - Expensive to store, is at its peak in fall just prior to the peak demand
    - Demand: winter high
    - Southern hemisphere
        - Peaks in June and July rather than Dec and Jan
    - Topical areas
        - Relatively flat
- Oil
    - Easier to transport than gas
    - Demand is high in one hemisphere when it is low in the other.
    - Constant demand, long-run price more stable
- Commodity spread
    - A commodity spread results from a commodity that's an input in the production process of other commodities.
    - **Cracking**
        - Gas -> crude oil 原油, heating oil, kerosene 煤油, gasoline 汽油.
        - Crack spread
        - No interest adjustment when calculating
- Basis risk 基差风险
    - Basis = spot price – future price
    - Basis risk: spot and futures price do not move together perfectly
    - Commodity: Storage and transportation cost
    - 基差风险是指保值工具与被保值商品之间价格波动不同步所带来的风险
    - 基差(basis)即现货成交价格与交易所期货价格之间的差
    - 类型

        - 风险暴露基差(exposure risk)，它是由所谓的交叉套期保值(cross-hedge)(即以某类利率作为依据的期货合同来抵补以另一类别的利率作为依据的某现货市场金融工具的敞口风险)而产生的风险。
        - 期限基差(period basis)，即现货市场金融工具面临风险的期限与保值工具期限不一致所产生的风险。
        - 收敛基差(convergence basis)，它是期货市场价格与现货市场价格变化不一致产生的风险。
- Strip hedge 带状避险
    - 一对一避险..比如今后三个月每月交付原油,就买期限 1 个月、2 个月、3 个月的期货避险
    - oil producer, fix price and amount for refinery.
    - Enter several future3s contract, matching the **maturities and quantities**
    - If price rise, gains on the future offset the lost gains on the fixed price agreement
- Stack hedge
    - Stack and roll. 滚动避险， 迭状避险
    - Reduce transaction cost, buy month after month
    - 计算三个月所需原油总量,购买期限 1 个月的期货,到期后滚动购买,即所谓 stack and roll. stack hedge 的交易成本较低,但由于期限不同所以有基差风险
    - a large near-term contract
- example
    - supply 150,000 barrels of oil each month
    - strip: a long futures contract for every month for 150,000 barrels
    - stack
        - a long position of a near-term futures contract for a little les than 1,800,000 barrels.
        - End of the month, a new contract for a smaller amount representing the value of future deliveries
- cross hedging 交叉保值
    - exactly the same position will not exist
    - no jet fuel future, hedge use crude oil or heating oil futures
    - three factors
        - **liquidity** of the future contract
            - can easily unwind
        - **correlation** between the underlying for the futures contract and the asset being hedged.
        - The **maturity** of the future contract
    - Cross hedge Weather derivatives
        - Agricultural, recreational
        - Utility companies hedge cost of energy purchases
    - 在期货市场上没有与现货商品相同的商品，就利用与现货商品关系最密切的商品保值。

Exchanges, OTC Derivatives, DPCs and SPVs

- exchange

    - product standardization
        - delivery grades, locations, trading price increments, maturity dates
    - trading venue
        - physical locations or electronic platforms
        - a central location for trading, facilities price discovery.
    - reporting services
        - participants, vendors, subscribers
- forms of clearing
    - clearing: a process of reconciling and matching contracts between counterparties from the time the commitments are made until settlement.
    - Clearing, margining, and netting are important counterparty risk mitigants
    - Margining
        - Initial and variation margins
    - Netting
        - Consolidating multiple offsetting positions into a single payment.
    - Direct clearing
        - Bilaterally between two counterparties.
        - Netting, payment of difference
    - Clearing ring
        - Reduce counterparty exposure between three or more members.
        - X -> Y -> Z -> X->Z
        - Improve liquidity and facilitate the close-out process.
    - Complete clearing
        - Clearing through a central counterparty (CCP)
        - Use margin rules: initial margin: offset closeout cost,
        - Variation margin: settlement of daily profit and loss
- Exchange-traded and OTC
    - Exchange – basis risk
        - Liquid, active, regulated
        - Exchange or CCP acts as the central counterparty
    - OTC – credit risk
        - Privately bilateral contracts
        - High level of customization: reduce basis risk, mismatches
        - Credit risk is a concern
        - Unwind a trade is difficult
- Clearing (CCP vs bilaterally)
    - Exchange: shorter term and settled within a few days
    - OTC: longer term with later settlements.
        - Can also be cleared via. CCPs
- OTC Classes
    - Classes: interest rate, foreign exchange, equity, commodity, credit derivatives
    - Interest rate > foreign exchange > credit default swaps > equity > commodity
    - Counterparty risk: foreign exchange, exchange of notional principal
    - Fixed-for-floating Interest rate swap: exchange coupon, no principal risk
    - Gross notional value is misleading, use **gross market value**, and its ratio 3%
- CDS: credit default swap
    - wrong-way risk, more volatile

- Reduce OTC risk
    - Tools: capital requirements, regulation, netting, margining.
    - Systematic risk: CCP
- Special purpose vehicles (SPVs)
    - Bankruptcy remote legal entities set up by a parent company to shield SPV from any financial distress of the firm.
    - Firm -> assets to SPV, issue structured products to investors
    - Obtain a strong credit rating, AAA.
    - Issue securities through SPV.
    - Alter bankruptcy rules and transform counterparty risk into legal risk.
        - Consolidation: view SPV and originating firm as a single legal entity.
    - 特殊目的机构
    - SPV 的原始概念来自于中国墙（ChineseWall）的风险隔离设计，它的设计主要为了达到“破产隔离”的目的。
    - SPV 的法律形态主要有信托、公司、有限合伙三种。
- Derivative product companies (DPCs) 衍生产品的公司
    - By Firms as bankruptcy remote subsidiaries to originate derivative prodeuct and sell them to investors.
    - Unlike SPV, to receive AAA, they are separately capitalized.
    - Three criterion
        - Marker risk minimization via. Both side of market
        - Parent support, shield against parent’s distress
        - Credit and operational risk mgt like limts, margin, daily markt to market
    - Obsolete
- Credit derivative product companies (CDPCs) – credit default swap, insurance
    - 债券保险商 Monolines: insurance companies, credit swaps to investors
    - CDPC is similar to DPC, more close to monolines
    - Fell out of favour
- Lessons
    - Legal risk: SPVs and DPCs

Basic Principles of Central Clearing

- CCP 共同对手方，结算机构
- Clearing and settlement
- Clearing
    - The process (margining and netting) between the period from trade execution until settlement.
- Settlement
    - When the trade is complete
- CCP
    - Improve liquidity, transparency,
    - Reduce credit risk
- Auction process
    - When a member default, auction rather than close out trades
- Loss mutualisation

    - Insurance, contribute to default fund to cover future losses
- Products
    - A long history: interest rate swap
    - A short history: index credit default swap
    - Soon be centrally cleared: interest rate swaption, CDS
    - Not suitable: exotic derivation (Asian options), illiquid assets
    - Conditions
        - Standarization:
        - Complexity: easily valued, vanilla not exotic
        - Liquidity: more liquidity
- Participants
    - Admission criteria: credit quality (grade), size (>=50m)
    - Financial commitment: contribute to default fund
    - Operational criteria: post margin
- Number of CCP
    - A single is optimal but realistic
    - Regional difference: currency, law regulation of the region
    - Product type
    - Regulatory reasons:
- Type
    - utility-driven: long-term stability rather than short-term profits
    - profit-driven: bottom line to attract personnel and build the best system.
- Failure of CCP
    - Support from a central bank
- Central clearing
    - Props
        - Transparency
        - Offsetting: reduce costs
        - Loss mutualisation
        - Legal and operational efficiency
        - Liquidity
        - Default management: auction process
    - Cons
        - Moral hazard
            - Party take higher risk
        - Adverse selection
        - Bifurcation: increase cash flow volatility for hedged produts
        - procycliality
            - increase margin in volatile market aggravate systemic risk
- Margining
    - Post cash or marketable security collateral
    - Initial margin: cash or liquid assets, cover worst-case default
    - Variation margin: cover daily net change of position
    - Normally set based on risk of **transactions**
    - For initial, do not consider credit of member, and post the same
- Novation and netting
    - 更新，以新的代替

    - novation:
        - legal process of interposing CCP between the seller and buyer
        - one contract is replaced with another with CCP
        - old contract cease to exist
        - CCP maintain “matched book”
    - Netting/Multilateral offsetting 多边净额结算
        - Each party and CCP
- Increase risk: higher initial margin during stress

Risks Caused by CCPs

- Default risk
    - Failed auction, insufficient bids,
    - Pass loss to other member -> more default, unfair
    - VMGH: variation margin gains haircutting
        - Cannot receive full gains
        - Ow money to CCP still need to pay full
    - Tear-up
        - Terminates unmatched position
    - Some members may resign from CCP -> more resign
        - The initial and default funds must be returned
- Model risk
    - Not priced by the market, using valuation models that performs mark-to-market function
    - Models are linear, initial margin, too low for large or concentrated position
    - Margin multiplier
- Liquidity risk
    - Short-term: depositions, repos, and reverse repos
    - Cannot be quickly convert to cash
- Operational
    - System failure, internal/external fraud
- Legal
    - Involve netting arrangements.
- Other
    - Investment risk: loss of margin funds
    - **Settlement and payment** risk: bank stop providing cash settlement
        - More likely during crisis period
    - Foreign exchange risk:
    - Custody risk: loss security, margins by a custodian due to failure, farud, negligence
    - Concentration: lack of diversity
    - Sovereign risk: foreign government default
    - Wrong-way risk: exposure is negatively correlated with the credit quality
- Risk to clearing members and non-members
    - Non-member: no loss as long as one member if solvent
    - Non-member
        - Cannot finish trade, close out at a loss

    - Member can pass losses by VMGH or tear-up, reduce gains
        - Cannot pass loss from default fund, right of assessment and forced allocation.
- Lessons
    - Operational risk: system robust
    - Variation margins: update often and quickly
        - Cross-margin linkage between CCP -> liquidity risk
    - Initial margin and default funds large enough
    - Monitor positions, penalized overly concentrated positions
    - One or more external sources of liquidity

Foreign Exchange Risk

- Net position exposure
    - (Asset/loan – liabilities/deposit) + (brought – sold)
    - net assets + net bought
- positive net exposure (>0), net long in a currency
    - risk, foreign currency will fall
- negative net exposure, net short, risk: rise
- alter net position exposure
    - match its asserts to liabilities, match long and short in trading positions
    - long in one component and short in the other component
- Gain/loss
    - Dollar gain/loss in EUR = net EUR exposure ($) * %change in $/FC rate
- Trading activities
    - Enable customers to participate in the internal commercial business
    - Enable to take positions in real/financial foreign investments
    - Offset exposure in a given currency for hedging purposes
    - Speculating on foreign currencies in search of profit by forecasting and anticipating futures FX rate movements.
- Potential gains/loss
    - Mismatched foreign asset/liability positions
- on-balance-sheet hedging
    - a matched maturity and currency foreign asset-liability book.
- off-balance-sheeting hedging
    - take a position in forward market
- interest rate parity
    - forward (1+r_F)^T = spot (1+r_D)^T
    - forward exp(r_F)^T = spot exp(r_D^T) =>
        - forward = spot exp ((r_D – r_F)^T)
- diversification
    - nominal interest rate = real interest rate + expected inflation rate
-

Corporate Bonds

- https://wenku.baidu.com/view/d4addffd3186bceb19e8bb91.html
- fixed-interest bond 固定利率票息

    - participating bond (at least) 参与债券
    - income bond (at most) 收益债券
- floating-rate bond 浮动利率票息
    - widely used reference: LIBOR or federal funds rate
- zero-coupon bond 零票息
    - deferred-interest bond (DIB)
        - not pay cash interest for some years
    - payment-in-kind bond (PIK)
        - pay interest with additional bonds for the initial period
        - then cash interest after period ends
- 票面价值 face value
- 发行价格：相对于票面价值的百分比。溢价、平价 100%、折价
- 交割金额：买方付给卖方的总金额
- convertible, callable, putable
- callable 可赎回债券/发行商
- puttable 可卖回债券/投资人
- original-issue discount(QID) = face value – offering price
    - reinvestment risk
- types
    - indenture 契约; 合同; 正式凭单; 文据;
    - mortgage bonds 不动产抵押债券
        - issued in a series in a blanket arrangement
    - collateral trust bonds 抵押信托债券
        - stocks, notes, bonds
    - equipment trust certificates (ETC) – 设备抵押债券
        - trustee purchase equipment and lease it to the user
        - payment is called dividends
    - indenture – unsecured bonds (no assets underlying the issue)
    - Guaranteed bonds 保证债券
        - Issued by one company can be guaranteed by other companies
    - debenture 无担保债券/信用债券
    - asset-backed securities 资产担保债券
    - subordinated debenture bonds 附属信用债券
        - bonds are unsecure and
        - have another unsecured bond with a higher claim above them.
    - Convertible debentures 可转换债券
        - Give the bondholder the right to convert the bond into common stock
    - Exchange debentures
        - Convertible into common stock of a corporation other than the issuer
    - Voting bonds 投票权债券
- 其它
    - 商业票据 commercial paper
    - 银行承兑汇票 bill of exchange
    - 大额可转让存单 CDs
    - 外国债券 foreign bond

    - 欧洲债券 european bond
- rating bond
- credit risk
    - credit default risk
    - credit spread risk 信用差价风险
    - spread duration
        - the change of price for a 100 basis point change In the spread
        - 4: means 50 basis point change the price by 2%
- Event risk
    - Mergers, recapitalization, restructuring, acquisitions,
    - Position put: require company to repurchase the debt.
- High-yield bond
    - Businessman's risk: bond whose rating is at the bottom rung (BBB) or at the top end of the speculative-grade BB
    - Bonds with non-investment grade raring
        - Young company, growing companies, story bond
    - Fallen angles
        - Issued with a grade, but led to lower rating below grade
        - Near bankruptcy, special situations
    - Restructuring and leveraged buyouts
    - Reset bond
        - Periodically Reset the coupon to reflect market rates
    - Deferred-coupon structures
        - Deferred-interest bonds
            - No coupon in the first 3-7 years
        - Step-up bonds
            - Low in the beginning, higher
        - Payment-in-kind
            - Pay additional bond in the initial period
- Default rate
    - Issuer default rate
    - Dollar default rate
- Recovery rate
    -

Mortgages and Mortgage-Backed Securities

- Securitization
    - Mortgage backed securities (MBS)
    - Special purpose vehicle (SPV)
    - Origination mortgage loans -> issuer in SPV -> back MBS
- Pass-through securitization
    - A pool of mortgages
    - Pool different maturities and rates
    - Weighted average maturity (WAM)
        - Weight: relative outstanding balance
    - Weighted average coupon (WAC)
        - Weight: rates

    - Pass-through rates = coupon rates – servicing, guarantee/issuance fee
    - Convert illiquid mortgage into liquid securities
    - Most risk: prepayment risk
- Measuring prepayment speeds
    - Conditional prepayment rate (CPR)
        - Annual rate that a poll is prepaid
        - (1 – SMM)^12 = 1 - CPR
    - Public securities association (PSA)
        - CPR=0.2%*month (for first 30 months)
        - CPR=6% (30 to 360)
- Trading pass-through securities
- Dollar roll transaction
    - Buy for one month and sell another month
- How to value a dollar roll?
    - Income (coupon, reinvested interest, principal payments)
    - Expense (repo market)
    - Purchase in front month Net cash flow = vaue in the back month
- Factors
    - Decrease in back month price (more sales)
    - Increase in front price (increased demand)
    - Shortages of certain securities
- Collateralized mortgage obligations
    - extension (increase in expected life of a pool, raising interest and lower prepayment rates)
    - contraction (decrease in life, fall interest rate, higher prepayment rate)
    - against pass-through securities
    - cash -> different tranches
        - different claim against the cash flow
        - different mixture of contraction and extension risk
    - PAC (planned amortization class) + support/companion
        - Sinking fund
    - PAC comes at the increased risk of support tranches
- Strips
    - Principal + interest
    - Principal-only strips (PO)
        - Sold at discount
        - Small -> increase
        - High prepayment -> faster -> high yield
        - Lower interest -> high prepayment
    - Interest-only strips (IO)
        - Bigger -> small
        - High prepayment -> less interest
    - Both higher volatility, negative correlated
- Prepayment Modelling
    - Refinancing
        - Mortgage Interest fall
        - Property price increase -> cash-out refinancing

        - Refinance burnout
    - Turnover
        - Due on sale
        - Lock-in effect
    - Defaults
        - Loan-to-value (LTV)
    - curtailments
        - partial payments
        - older or low balance
- Dynamic valuation
    - Binomial model
        - Interest rate do not change over time
    - Monte carlo
        - Best guess
        - A distribution: mean
    - Step
        - Interest rate path and refinancing path
            - Monthly interest rate
            - Volatility
            - Short yield volatility > long yield volatility
            - term structure yield volatility
        - Cash flows for each interest path
            - Principal + net interest + prepayments
        - PV for each interest path
            - Discount interest rate
        - Theoretical value
- Option-adjusted spread (OAS)
    - The spread K,
    - Market price = average price
    - The compensation risk for prepayment
- Zero-volatility spread
    - No impact that prepayment risk or changing
- Option cost = ZVS – OAS
- OAS
    - Modelling risk with MC simulation
    - Required adjustment to interest rate path
    - Constant OAS
    - Dependency of underlying prepayment model