



金程教育
GOLDEN FUTURE

专业·领先·增值

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CFA一级培训项目

Quantitative Methods



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R5 Time Value of Money

- Time Value of Money
 1. Required interest rate on a security的组成
 2. EAR
 3. Annuities的计算: FV, PV, required payment

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R5 Time Value of Money

- Decompose required rate of return:
 - Nominal risk-free rate = real risk-free rate + expected inflation rate
 - Required interest rate on a security
 - = nominal risk-free rate + default risk premium + liquidity risk premium + maturity risk premium
- 考察方法:
 - Real risk-free rate和nominal risk-free rate的关系

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R5 Time Value of Money

2015.12 (1)
2015.06 (1)

➤ EAR calculation:

$$\text{EAR} = (1 + \text{periodic rate})^m - 1 \longleftrightarrow 1 + \text{EAR} = \left(1 + \frac{r}{m}\right)^m = e^r$$

- 那么如果是semi, m=2; 如果是quarterly, m=4
- 如果是连续复利, 公式则变为 $\text{EAR} = e^{\text{annual int}}$

考察方法:

- 计算——算EAR, 或者是算计息次数
- 定性 (EAR和计息次数有关)
 - The greater the compounding frequency,
 - ✓ the greater the EAR will be in comparison to the stated rate
 - ✓ the greater the difference between EAR and the stated rate

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R5 Time Value of Money

2015.12 (2) 2015.06 (1)
2014.12 (2+1) 2014.06(1+1)

➤ Type of annuity

- Ordinary annuity (后付年金)
- Annuity due (先付年金)
 - ✓ Definition: an annuity where the annuity payments occur at the beginning of each compounding period.
 - ✓ Calculation:
 - ◆ Measure 1: put the calculator in the BGN mode and input relevant data.
 - ◆ Measure 2: treat as an ordinary annuity and simply multiple the resulting PV by $(1+I/Y)$
- Perpetuity (永续年金)
 - ✓ Definition: A perpetuity is a financial instruments that pays a fixed amount of money at set intervals over an infinite period of time.
 - ✓ Calculation:
$$\text{PV} = \frac{\text{PMT}}{1+I/Y} + \frac{\text{PMT}}{(1+I/Y)^2} + \frac{\text{PMT}}{(1+I/Y)^3} + \dots = \frac{\text{PMT}}{I/Y}$$

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R6 Discounted Cash Flow Applications

➤ Discounted Cash Flow Applications

1. NPV & IRR
2. 计算HPY, EAY等收益率, 以及它们相互之间的转化
3. Money-weighted return & Time-weighted return

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R6 Discounted Cash Flow Applications

2015.06 (1)
2014.12 (1)

$$NPV = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \dots + \frac{CF_N}{(1+r)^N} = \sum_{t=0}^N \frac{CF_t}{(1+r)^t}$$

$$NPV = 0 = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \dots + \frac{CF_N}{(1+IRR)^N} = \sum_{t=0}^N \frac{CF_t}{(1+IRR)^t}$$

IRR (Internal Rate of Return)

- When NPV= 0, the discount rate.
- Multiple solutions Problem of the IRR calculation (# sign changes)
- Basic assumption: Reinvestment rate = IRR

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R6 Discounted Cash Flow Applications

2015.12 (1)

➤ Project Decision Rule

- Single project Case
 - ✓ NPV method: Accept it if NPV>0
 - ✓ IRR method: Accept it if IRR>r (required rate of return)
- Two Projects Case
 - Independent Projects**
 - ✓ Similar to Single projects case
 - Mutually Exclusive Projects**
 - ✓ NPV method: Choose the one with higher NPV
 - ✓ IRR method: Choose the one with higher IRR
 - ✓ NPV and IRR methods may conflict with each other

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R6 Discounted Cash Flow Applications

2015.12 (1) 2015.06 (1)
2014.12 (1)

$$r_{BD} = \frac{(F - P_0)}{F} \times \frac{360}{t}$$

$$HPR = \frac{P_1 - P_0 + CF_1}{P_0}$$

$$r_{MM} = HPR \times \frac{360}{t}$$

$$EAR = (1 + HPR)^{365/t} - 1$$

$$\left(1 + \frac{BEY}{2}\right)^2 = 1 + EAR$$

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Example

1. An investor buys a T-bill at 98,000 with 50 days to maturity. The par value of this T-bill is 100,000. The money market yield is closest to:
A. 14.6%
B. 14.7%
C. 14.9%
➤ Correct answer : B
2. A U.S. Treasury bill (T-bill) has 90 days to maturity and a bank discount yield of 3.25%. The effective annual yield (EAY) for the T-bill is closest to:
A. 3.29%.
B. 3.32%.
C. 3.36%.
➤ Correct answer: C

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R6 Discounted Cash Flow Applications

2015.06 (1) 2014.12 (1)
2014.06 (1)

Money-weighted and time-weighted Rate of Return

- time-weighted return掌握概念及公式:
- 概念: Time-weighted rate of return measures compound growth.
 - 步骤及公式: Firstly, compute the HPR; then, compute $(1+HPR)$ for each subperiod to obtain a total return for the entire measurement period [eg. $(1+HPR_1) * (1+HPR_2) \dots (1+HPR_n)$].
- money-weighted return掌握概念及公式:
- 概念: the IRR based on the cash flows related to the investment
 - 步骤及公式: Firstly, determine the timing of each cash flow; then, using the calculation to compute IRR, or using geometric mean.
- 考察方法: 1.计算; 注意计算time-weighted return时, 如果不是年度的HPR不用开方; 2.性质: 用TWRR衡量基金经理的投资业绩。

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Example

- An analyst gathered the following information (\$ millions) about the performance of a portfolio:

| Quarter | Value at Beginning of Quarter (Prior to inflow or outflow) | Cash inflow (outflow) At Beginning of Quarter | Value at Quarter End |
|---------|--|---|----------------------|
| 1 | 2.0 | 0.2 | 2.4 |
| 2 | 2.4 | 0.4 | 2.6 |
| 3 | 2.6 | (0.2) | 3.2 |
| 4 | 3.2 | 1.0 | 4.1 |

- The portfolio annual time-weighted rate of return is closest to:
A. 8%
B. 27%
C. 32%
➤ Correct answer: C

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R7 Statistical Concepts and Market Return

➤ Statistical concepts

1. Types of measurement scales
2. Measures of central tendency
3. Quantile
4. MAD和Var计算以及比较
5. Chebyshev's inequality
6. CV & Sharp ratio
7. Skewness & Kurtosis

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R7 Statistical Concepts and Market Return 2014.12 (1) 2014.06 (1)

Types of measurement scales:

➤ Nominal scales

- distinguishing two different things, no order, only has mode
- example: assigning the number 1 to a municipal bond fund, the number 2 to a corporate bond fund.

➤ Ordinal scales (>, <)

- making things in order, but the difference are not meaningful
- example: the ranking of 1,000 small cap growth stocks by performance may be done by assigning the number 1 to the 100 best performing stocks

➤ Interval scales (>, <, +, -)

- subtract is meaningful
- example: Temperature

➤ Ratio scales (>, <, +, -, *, /)

- with original point
- example: money, if you have zero dollars, you have no purchasing power, but if you have \$4.00, you have twice as much purchasing power as a person with \$2.00.

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R7 Statistical Concepts and Market Return

2015.06 (1)

2014.06 (1)

Frequency distribution

| Interval | Absolute | Relative | Cumulative | Cumulative |
|--------------|------------|-------------|--------------------|------------|
| Relative | Frequency | Frequency | Absolute Frequency | Frequency |
| -10 - -5 | 3 | 0.97% | 3 | 0.97% |
| -5 - 0 | 35 | 11.29% | 38 | 12.26% |
| 0 - 5 | 176 | 56.77% | 214 | 69.03% |
| 5 - 10 | 74 | 23.87% | 288 | 92.90% |
| 10 - 15 | 22 | 7.10% | 310 | 100% |
| Total | 310 | 100% | | |

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R7 Statistical Concepts and Market Return

2015.12 (1+1)
2014.12 (1) 2014.06 (1)

The arithmetic mean:

$$\bar{X} = \frac{\sum_{i=1}^N X_i}{n}$$

The weighted mean:

$$\bar{X}_w = \sum_{i=1}^n w_i X_i = (w_1 X_1 + w_2 X_2 + \dots + w_n X_n)$$

The geometric mean:

$$G = \sqrt[N]{X_1 X_2 X_3 \dots X_N} = \left(\prod_{i=1}^N X_i \right)^{1/N}$$

The harmonic mean:

$$\bar{X}_H = \frac{n}{\sum_{i=1}^n (1/X_i)}$$

harmonic mean ≤ geometric mean ≤ arithmetic mean

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R7 Statistical Concepts and Market Return

2014.12 (1) 2014.06 (1)

➤ Quantiles

- Quartile / Quintile / Deciles / Percentile

✓ The third quartile: 75%, or three-fourths of the observations fall below that value.

- Calculation $L_y = (n+1)y/100$, L_y is the position.

➤ Quantiles and measures of central tendency are known collectively as measures of location.

➤ Example:

The median of a distribution is least likely equal to the:

- Second quartile
- Third quintile
- Fifth decile

➤ Correct answer: B

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R7 Statistical Concepts and Market Return

2015.12 (1) 2015.06 (1)
2014.12 (1)

Range = maximum value – minimum value

$$MAD = \frac{\sum_{i=1}^N |X_i - \bar{X}|}{n}$$

Note: MAD < Variance

$$\text{For population: } \sigma^2 = \frac{\sum_{i=1}^N (X_i - \mu)^2}{N}$$

$$\text{For sample: } s^2 = \frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}$$

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R7 Statistical Concepts and Market Return

2015.06 (1)

➤ Chebyshev's inequality

- For any set of observations (samples or population), the proportion of the values that lie within k standard deviations of the mean is at least $1 - 1/k^2$, where k is any constant greater than 1.
- 对任何一组观测值，个体落在均值周围k个标准差之内的概率不小于 $1 - 1/k^2$ ，对任意 $k > 1$ 。
- This relationship applies regardless of the shape of the distribution

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R7 Statistical Concepts and Market Return

➤ Coefficient of variation measures the amount of dispersion in a distribution

relative to the distribution's mean. (relative dispersion)

2015.12 (2) 2014.12 (1)
2014.06 (1)

$$CV = \frac{s_x}{\bar{X}} \times 100\%$$

➤ The sharp ratio measures excess return per unit of risk. 2015.06 (1)

$$\text{Sharp ratio} = \frac{R_P - R_f}{\sigma_P}$$

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Example

➤ An analyst gathered the following information:

| Portfolio | Mean Return (%) | Sharpe ratio (%) |
|-----------|-----------------|------------------|
| 1 | 9.8 | 34.17 |
| 2 | 10.5 | 36.95 |

➤ If the risk-free rate of return is 3.0 percent, which portfolio's coefficient of variance is larger?

- A. Portfolio 1
- B. Portfolio 2
- C. The same

➤ Solution: A

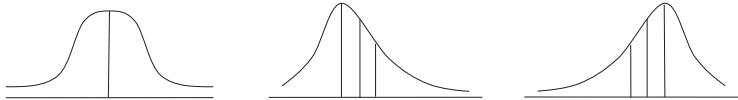
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R7 Statistical Concepts and Market Return

2015.12 (1) 2015.06 (1)
2014.12 (1) 2014.06 (1)



- Mean=Median=Mode

Symmetrical
- Mode<Median<Mean

Positive (right) skew
- Mean<Median<Mode

Negative (left) skew
- Positive skewed: Mode<median<mean, having a right fat tail
- Negative skewed: Mode>media>mean, having a left fat tail
- Investors should be attracted by a positive skew because the mean return falls above the median.
- Sample skewness:

$$S_K = \left[\frac{n}{(n-1)(n-2)} \right] \frac{\sum_{i=1}^n (X_i - \bar{X})^3}{s^3} \approx \left(\frac{1}{n} \right) \frac{\sum_{i=1}^n (X_i - \bar{X})^3}{s^3}$$

- 考察方法:
- 根据描述的特点判断是Positively skewed还是Negative skewed
- 根据已知的偏度，选择都有哪些特点

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R7 Statistical Concepts and Market Return

- Leptokurtic vs. platykurtic
 - It deals with whether or not a distribution is more or less “peaked” than a normal distribution
- Excess kurtosis = sample kurtosis – 3

| | leptokurtic | Normal distribution | platykurtic |
|-----------------|-------------|---------------------|-------------|
| Sample kurtosis | >3 | =3 | <3 |
| Excess kurtosis | >0 | =0 | <0 |

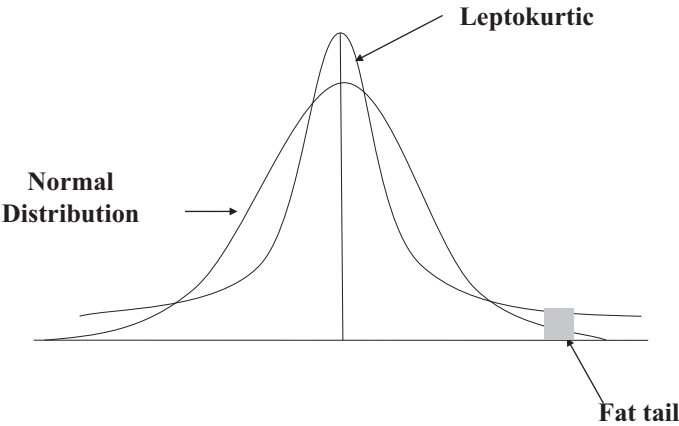
- 考察方法:
- 根据描述的特点判断是leptokurtic还是platykurtic
- 根据已知的峰度，选择都有哪些特点
- 可能在考试中会和skew合并考核综合知识

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R7 Statistical Concepts and Market Return



A leptokurtic return distribution has more frequent extremely large deviations from the mean than a normal distribution.

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R8 Probability Concepts

➤ Probability concepts

- Two defining properties of probability
- Empirical, subjective, and priori probabilities
- Odds for or against
- Multiplication rule and addition rule
- Dependent and independent events
- Covariance & correlation
- Expected value, variance, and standard deviation of a random variable and of returns on a portfolio
- Bayes' formula

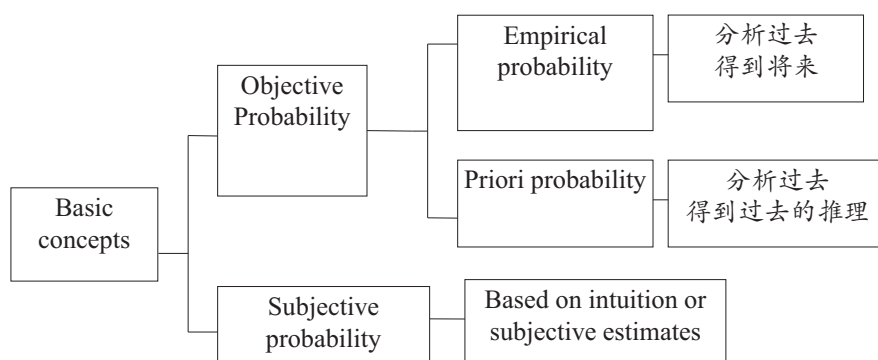
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R8 Probability Concepts

2014.12 (1) 2014.06 (1)



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R8 Probability Concepts

2015.12 (1) 2014.06 (2)

➤ Odds for an event

- $P(E)/(1-P(E))$

➤ Odds against an event

- $(1-P(E))/P(E)$

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R8 Probability Concepts

2015.12 (2) 2015.06 (2)
2014.12 (1) 2014.06 (2)

- Joint probability : $P(AB)$
- Multiplication rule:
 $\checkmark P(AB)=P(A|B) \times P(B)=P(B|A) \times P(A)$
 - If A and B are mutually exclusive events, then:
 $P(AB)=P(A|B)=P(B|A)=0$
- Probability that at least one of two events will occur:
- Addition rule:
 $\checkmark P(A \text{ or } B)=P(A)+P(B)-P(AB)$
 - If A and B are mutually exclusive events, then:
 $P(A \text{ or } B)=P(A)+P(B)$

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R8 Probability Concepts

- The occurrence of A has no influence of on the occurrence of B
- $P(A|B)=P(A)$ or $P(B|A)=P(B)$
 - $P(AB)=P(A) \times P(B)$
 - $P(A \text{ or } B)=P(A)+P(B)-P(AB)$
- **Independence and Mutually Exclusive** are quite different
- If exclusive, must not independence;
 - Cause exclusive means if A occur, B can not occur, A influences B.
 $\checkmark P(AB)=P(A) \times P(B)$

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R8 Probability Concepts

- Expected value: $E(X) = \sum P(X_i)X_i$
- $$E(X) = \sum x_i * P(x_i) = x_1 * P(x_1) + x_2 * P(x_2) + \dots + x_n * P(x_n)$$
- $$\sigma = \sqrt{\sigma^2} \quad \sigma^2 = \sum_{i=1}^N P_i(X_i - EX)^2$$

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R8 Probability Concepts

2015.12 (1) 2015.06 (1)
2014.12 (1) 2014.06 (1)

➤ Covariance:

- Covariance measures how one random variable moves with another random variable
- The covariance of R_A with itself is equal to the variance of R_A
- Covariance ranges from negative infinity to positive infinity

$$\text{COV}(X, X) = E[(X - E(X))(X - E(X))] = \sigma^2(X)$$

$$\text{COV}(X, Y) = E[(X - E(X))(Y - E(Y))]$$

➤ Correlation:

$$\rho_{XY} = \frac{\text{COV}(X, Y)}{\sigma_X \sigma_Y}$$

- Correlation measures the **linear relationship** between two random variables
- Correlation has no units, ranges from -1 to $+1$, standardization of covariance
- Understand the difference between correlation and independence
- If $\rho=0$, this indicates?

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Example

- An analyst gathered information about three economic variables, He noted that whenever variable A increased by one unit, variable B increased by 0.5 units but variable C decreased by 0.5 units. The correlation between variables A and B and the correlation between variables A and C respectively, are closest to:

Correlation between variables A and B Correlation between variables A and C

| | | |
|---|-----|------|
| A | 0.5 | -1.0 |
| B | 0.5 | -0.5 |
| C | 1.0 | -1.0 |

- A. Answer A
- B. Answer B
- C. Answer C

- Correct answer: C

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R8 Probability Concepts

2014.12 (1)

- The expected value, variance, and standard deviation of a random variable and of returns on a portfolio;

$$E(r_p) = \sum_{i=1}^n w_i E(R_i)$$

$$\sigma_p^2 = \sum_{i=1}^n \sum_{j=1}^n w_i w_j \text{cov}(R_i, R_j)$$

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R8 Probability Concepts

2015.06 (1)

2014.12 (1) 2014.06 (1)

- Multiplication rule: $n_1 \times n_2 \times \dots \times n_k$
- Factorial: $n!$
- Labeling (Multinomial Formula): $\frac{n!}{n_1! \times n_2! \times \dots \times n_k!}$
- Combination: ${}_nC_r = \frac{n!}{(n-r)! \times r!}$
- Permutation: ${}_nP_r = \frac{n!}{(n-r)!}$

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R9 Common Probability Distributions

- Common Probability Distributions
 - Properties of discrete distribution and continuous distribution
 - Uniform random variable and a binomial random variable
 - The key properties of the normal distribution
 - Standardize a random variable
 - Confidence interval for a normally distributed random variable
 - Lognormal distribution
 - Safety-first ratio
 - Monte Carlo simulation

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R9 Common Probability Distributions

- Probability Distribution
 - Describe the probabilities of all the possible outcomes for a random variable.
- Discrete and continuous random variables
 - Discrete random variables: the number of possible outcomes can be counted, and for each possible outcome, there is a measurable and positive probability.
 - Continuous variables: the number of possible outcomes is infinite, even if lower and upper bounds exist.
 - ✓ $P(x)=0$ even though x can occur.
 - ✓ $P(x_1 < X < x_2)$
- Probability density function (p.d.f) : $f(x)$
 - For continuous random variable commonly
- Cumulative probability function (c.p.f) : $F(x)$
 - $F(x)=P(X \leq x)$

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R9 Common Probability Distributions

2014.06 (1)

➤ Discrete uniform

- A discrete uniform random variable is one for which the probabilities for all possible outcomes for a discrete random variable are equal.
- For example, consider the discrete uniform probability distribution defined as $X=\{1,2,3,4,5\}$, $p(x)=0.2$.
 - ✓ Here, the probability for each outcome is equal to 0.2 [i.e., $p(1)=p(2)=p(3)=p(4)=p(5)=0.2$].

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R9 Common Probability Distributions

2015.06 (1)
2014.12 (1)

➤ Binomial distribution

- Bernoulli random variable
$$P(Y=1)=p \quad P(Y=0)=1-p$$
- Binomial random variable, the probability of x successes in n trials
$$p(x) = P(X = x) = {}_n C_x p^x (1 - p)^{n-x}$$
- Expectations and variances

| | Expectation | Variance |
|-------------------------------|-------------|-----------|
| Bernoulli random variable (Y) | p | $p(1-p)$ |
| Binomial random variable (X) | np | $np(1-p)$ |

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R9 Common Probability Distributions

2015.12 (1)
2014.06 (1)

➤ Continuous Uniform Distribution

--is defined over a range that spans between some lower limit, a , and upper limit, b , which serve as the parameters of the distribution.

➤ Properties of Continuous uniform distribution

- For all $a \leq x_1 < x_2 \leq b$
$$P(x_1 \leq X \leq x_2) = (x_2 - x_1) / (b - a)$$
- $P(X < a \text{ or } X > b) = 0$

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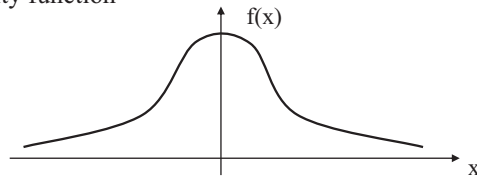
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R9 Common Probability Distributions

2015.12 (1)
2014.06 (1)

➤ The shape of the density function



➤ Properties:

- $X \sim N(\mu, \sigma^2)$
- Symmetrical distribution: skewness=0; kurtosis=3
- A linear combination of normally distributed random variables is also normally distributed.
- The tails get thin and go to zero but extend infinitely, asymptotic (渐近)

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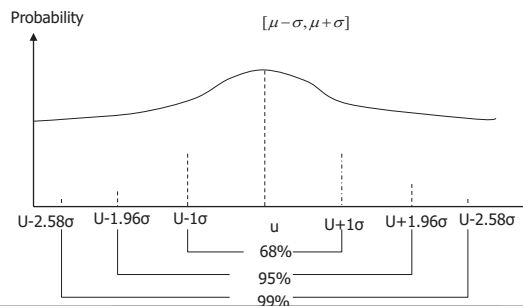
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R9 Common Probability Distributions

➤ The confidence intervals

- 68% confidence interval is $[\mu - 1.65\sigma, \mu + 1.65\sigma]$
- 90% confidence interval is $[\mu - 1.96\sigma, \mu + 1.96\sigma]$
- 95% confidence interval is $[\mu - 1.96\sigma, \mu + 1.96\sigma]$
- 99% confidence interval is $[\mu - 2.58\sigma, \mu + 2.58\sigma]$



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R9 Common Probability Distributions

2015.12 (1) 2015.06 (1)
2014.12 (2)

➤ Standard normal distribution

- $N(0,1)$ or Z
- Standardization: if $X \sim N(\mu, \sigma^2)$, then $Z = \frac{X - \mu}{\sigma} \sim N(0,1)$
- Z-table

➤ $F(-z) = 1 - F(z)$

➤ $P(Z > z) = 1 - F(z)$

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R9 Common Probability Distributions

2015.12 (1) 2015.06 (1)
2014.12 (1)

➤ Shortfall risk: R_L = threshold level return, minimum return required

- Minimize ($R_p < R_L$)

➤ Roy's safety-first criterion

$$[E(R_p) - R_L] / \sigma_p$$

➤ Maximize S-F-Ratio

- Maximize $SFR = \frac{E(R_p) - R_L}{\sigma_p} \Leftrightarrow$ Minimize $P(R_p < R_L)$

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R9 Common Probability Distributions

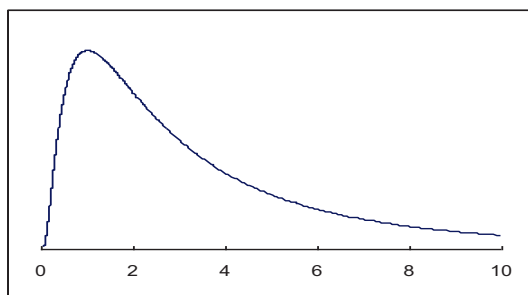
2014.06 (1)

➤ Definition: If $\ln X$ is normal, then X is lognormal, which is used to describe the price of asset

➤ Right skewed

➤ Bounded from below by zero

The lognormal distribution is used to model asset prices;



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R9 Common Probability Distributions

➤ Monte Carlo simulation vs Historical simulation

- Monte Carlo simulation uses randomly generated values for risk factors, based on their assumed distributions, to produce a distribution of possible security values, to analyze the complex instrument;

✓ Limitations:

- ◆ It is fairly complex and will assume a parameter distribution
- ◆ It is not an analytic method but a statistical one, and cannot provide the insights that analytic methods can.

- Historical simulation uses randomly selected past changes in these risk factors to generate a distribution of possible security values, can't answer the "What-If".

✓ Limitations: the past can not indicate the future and historical simulation cannot address the sort of "what if" questions that Monte Carlo simulation can.

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R10 Sampling and Estimation

- Sampling and Estimation
 - Simple random and stratified random sampling, time-series and cross-sectional data
 - Central limit theorem
 - Standard error of the sample mean的意义及计算
 - The desirable properties of an estimator
 - Student’s t-distribution的特点
 - Criteria for selecting the appropriate test statistic， 计算confidence interval
 - Five kinds of biases

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R10 Sampling and Estimation

- Sampling and estimation
 - Simple random sampling
 - Stratified random sampling: to separate the population into smaller groups based on one or more distinguishing characteristics. Stratum and cells=M*N
- Sampling error: sampling error of the mean= sample mean- population mean
- The sample statistic itself is a random variable and has a probability distribution.

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R10 Sampling and Estimation

2015.06 (1)

- Time-series data
 - consist of observations taken over a period of time at specific and equally spaced time intervals.
- Cross-sectional data
 - a sample of observations taken at a single point in time.

| Time-series data | Cross-sectional data |
|---|---|
| a collection of data recorded over a period of time | a collection of data taken at a single point of time. |

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R10 Sampling and Estimation

➤ Central Limit Theory 2015.06 (1) 2014.06 (1)

- For simple random samples of size n from a population with a mean μ and a variance σ^2 but without known distribution, the sampling distribution of the sample mean approaches $N(\mu, \sigma^2/n)$ if the sample size is sufficiently large ($n \geq 30$).

条件: 1. $n \geq 30$ 2. 总体均值方差都存在

结论: 1. 服从正态分布 2. $\mu_{population} = \mu_{sample}$ $s^2 = \sigma^2/n$

➤ Standard error of the sample mean

2015.12 (1) 2015.06 (1)
2014.12 (1) 2014.06 (1)

- Known population variance $\sigma_{\bar{x}} = \sigma / \sqrt{n}$
- Unknown population variance $s_{\bar{x}} = s / \sqrt{n}$

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R10 Sampling and Estimation

2015.12 (1)
2014.06 (1)

The desirable properties of an estimator:

- **Unbiasedness:** expected value of the estimator is equal to the parameter that are trying to estimate
- **Efficiency:** for all unbiased estimators, if the sampling dispersion is smaller than any other unbiased estimators, then this unbiased estimator is called efficient.
- **Consistency:** the accuracy of the parameter estimate increases as the sample size increases. **(the standard deviation of the parameter estimate decreases as the sample size increases)**
 - As the sample size increases, the standard error of the sample mean falls.

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R10 Sampling and Estimation

2015.12 (2) 2015.06 (1)
2014.06 (1)

- **Point estimate:** the statistic, computed from sample information, which is used to estimate the population parameter
- **Confidence interval estimate:** a range of values constructed from sample data so the parameter occurs within that range at a specified probability. **α —the level of significance**
- **Interval Estimation (also see Chapter: Hypothesis Testing)**
 - Level of significance (α)
 - Degree of Confidence ($1 - \alpha$)
 - Confidence Interval = [Point Estimate +/- (reliability factor) * Standard error]

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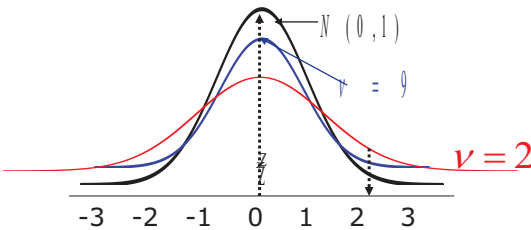


R10 Sampling and Estimation

2015.12 (2) 2015.06 (1)
2014.12 (1)

➤ Student’s t-distribution

- Symmetrical
- Degrees of freedom (df): n-1
- Less peaked than a normal distribution (“fatter tails”)
- As the degrees of freedom gets larger, the shape of t-distribution approaches standard normal distribution



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R10 Sampling and Estimation

2015.12 (1) 2015.06 (2)
2014.12 (1) 2014.06 (1)

➤ Calculate and interpret a confidence interval for a population mean, given a normal distribution with 1) a known population variance, 2) an unknown population variance, or 3) an unknown variance and a large sample size;

$$\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$$

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

| When sampling from a: | Test Statistic | |
|--|---------------------|----------------------|
| | small sample (n<30) | large sample (n>=30) |
| Normal distribution with known variance | z- Statistic | z- Statistic |
| Normal distribution with unknown variance | t- Statistic | t- Statistic/z |
| Nonnormal distribution with known variance | not available | z- Statistic |
| Nonnormal distribution with unknown variance | not available | t- Statistic/z |

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R10 Sampling and Estimation

2014.06 (1)

➤ Types of bias

- Data-mining bias
- Sample selection bias
- Survivorship bias
- Look-ahead bias
- Time-period bias

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R11 Hypothesis Testing

➤ Hypothesis testing

- The steps of hypothesis testing
- The null hypothesis and alternative hypothesis, one-tailed and two-tailed test
- Test statistics的选择和计算
- Type I and type II errors
- Decision rule
- The Chi-square test and F-test
- Parameter tests and non-parameter tests

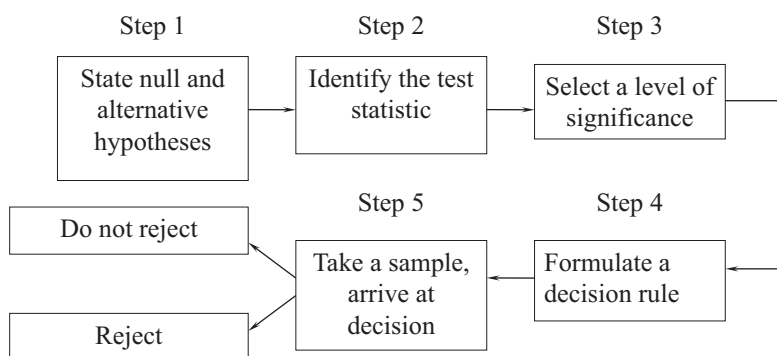
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R11 Hypothesis Testing

➤ Steps of hypothesis testing



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R11 Hypothesis Testing

2014.06 (1)

➤ Define Hypothesis

- Null hypothesis and Alternative hypothesis (we want to assess)

$$H_0 : \mu = \mu_0 \quad H_a : \mu \neq \mu_0$$

➤ One-tailed and Two-tailed tests of Hypothesis

Two-tailed $H_0 : \mu = \mu_0$ $H_a : \mu \neq \mu_0$

One-tailed $H_0 : \mu \leq \mu_0$ $H_a : \mu > \mu_0$
 or, $H_0 : \mu \geq \mu_0$ $H_a : \mu < \mu_0$

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R11 Hypothesis Testing

2015.12 (1)

➤ Test statistic

- Test for population mean

$$Test\ Statistic = \frac{\bar{X} - \mu_0}{\sigma / \sqrt{n}}$$

$$Test\ Statistic = \frac{\bar{X} - \mu_0}{s / \sqrt{n}}$$

➤ Critical value (关键值，实际就是分位数)

- Found in the Z, T, Chi Square or F distribution tables not calculated by us
- Under given one tailed or two tailed assumption, critical value is determined solely by the significance level.

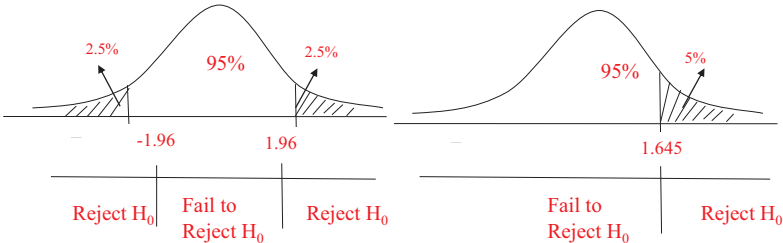
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R11 Hypothesis Testing

2014.06 (1)



- Reject H_0 if $|\text{test statistic}| > \text{critical value}$
- Fail to reject H_0 if $|\text{test statistic}| < \text{critical value}$
- **Statement**

- cannot say “accept the null hypothesis”, only can say “cannot reject”
 - ***** is significantly different from *****
 - ***** is not significantly different from *****

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R11 Summary of Hypothesis Testing

2015.12 (1) 2014.06 (1)

| Test type | Assumptions | H_0 | Test-statistic | Critical value |
|-----------------------------|---|---------------------------|---|-----------------------|
| Mean hypothesis testing | Normally distributed population, <u>known population variance</u> | $\mu = 0$ | $Z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$ | $N(0, 1)$ |
| | Normally distributed population, <u>unknown population variance</u> | $\mu = 0$ | $t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$ | $t(n-1)$ |
| | <u>Independent</u> populations, <u>unknown population variances assumed equal</u> | $\mu_1 - \mu_2 = 0$ | t | $t(n_1 + n_2 - 2)$ |
| | <u>Independent</u> populations, <u>unknown population variances not assumed equal</u> | $\mu_1 - \mu_2 = 0$ | t | t |
| | Samples <u>not independent</u> , paired comparisons test | $\mu_d = 0$ | $t = \frac{\bar{d}}{s_d / \sqrt{n}}$ | $t(n-1)$ |
| Variance hypothesis testing | Normally distributed population | $\sigma^2 = \sigma_0^2$ | $\chi^2 = \frac{(n-1)s^2}{\sigma_0^2}$ | $\chi^2(n-1)$ |
| | Two independent normally distributed populations | $\sigma_1^2 = \sigma_2^2$ | $F = \frac{s_1^2}{s_2^2}$ | $F(n_1 - 1, n_2 - 1)$ |

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R11 Hypothesis Testing

2015.12 (1)
2014.12 (1)

➤ P-value Method

- The **p-value** is the smallest level of significance at which the null hypothesis can be reject
- $p\text{-value} < \alpha$: reject H_0 ; $p\text{-value} > \alpha$: do not reject H_0 .
- $P \downarrow$, easier to reject H_0

➤ Example:

A two-tailed test of the null hypothesis that the mean of a distribution is equal to 4.00 has a p-value of 0.0567. Using a 5% level of significance (i.e., $\alpha=0.05$), the best conclusion is to:

- A. reject the null hypothesis.
- B. accept the null hypothesis.
- C. increase the level of significance to 5.67%.

➤ Correct answer: B

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R11 Hypothesis Testing

2015.12 (1) 2015.06 (1)
2014.12 (1)

| Decision | True condition | |
|------------------------|---|---|
| | H_0 is true | H_0 is false |
| Do not reject H_0 | <u>Correct Decision</u> | Incorrect Decision Type II error |
| Reject H_0 | Incorrect Decision Significance level α =P (Type I error) | <u>Correct Decision</u> Power of test = 1- P (Type II error) |

- With other conditions unchanged, either error probability arises at the cost of the other error probability decreasing.
- How to reduce both errors? Increase the Sample Size.

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Example

1. If a two-tailed hypothesis test has a 5% probability of rejecting the null hypothesis when the null is true, it is most likely that the:
 - A. Power of the test is 95%
 - B. Confidence level of the test is 95%
 - C. Probability of a Type I error is 2.5%

➤ Correct answer: B
2. Which of the following statements about hypothesis testing is most accurate?
 - A. Rejecting a true null hypothesis is a Type I error.
 - B. The power of a test is the probability of failing to reject the null hypothesis when it is false.
 - C. For a one-tailed test involving X, the null hypothesis would be $H_0: X=0$, and the alternative hypothesis would be $H_A: X \neq 0$.

➤ Correct answer: A

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Example

3. Joe Bay, CFA, wants to test the hypothesis that the variance of returns on energy stocks is equal to the variance of returns on transportation stocks. Bay assumes the samples are independent and the returns are normally distributed. The appropriate test statistic for this hypothesis is a(n):
- A. T-statistic.
 - B. F-statistic
 - C. Chi-square statistic.
- Correct answer: B
4. Alice Morton, CFA, is reviewing a research paper that reaches a conclusion based on two hypothesis with p-values of 0.037 and 0.064. Morton should conclude that:
- A. Both of these tests' null hypotheses can be rejected with 90% confidence.
 - B. Neither of these tests' null hypotheses can be rejected with 95% confidence.
 - C. Only one of these tests' null hypotheses can be rejected with 99% confidence.
- Correct answer: A

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Example

5. Using the sample results given below, drawn as 25 paired observations from their underlying distributions, test if the mean returns of the two portfolios differ from each other at the 1% level of statistical significance. Assume the underlying distributions of returns for each portfolio are normal and that their population variances are not known.
- | | Portfolio 1 | Portfolio 2 | Difference |
|--------------------|-------------|-------------|------------|
| Mean Return | 17.00 | 21.25 | 4.25 |
| Standard Deviation | 15.50 | 15.75 | 6.25 |
- t-statistic for 24 df and at the 1% level of statistical significance = 2.807
- Based on the paired comparisons test of the two portfolios, the most appropriate conclusion is:
- A. reject the hypothesis that the mean difference equals zero as the computed test statistic exceeds 2.807.
 - B. accept the hypothesis that the mean difference equals zero as the computed test statistic exceeds 2.807.
 - C. accept the hypothesis that the mean difference equals zero as the computed test statistic is less than 2.807.
- Correct answer: A

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R11 Hypothesis Testing

2015.12 (1)

- Parametric tests
- rely on assumptions regarding the distribution of the population
 - specific to population parameters.
 - For example, z-test.
- Nonparametric tests
- either do not consider a particular population parameter or have few assumptions about the population that is sampled.
 - Nonparametric tests are used:
 - ✓ When there is concern about quantities other than the parameters of a distribution.
 - ✓ When the assumptions of parametric tests can't be supported.
 - ✓ When the data are not suitable for parametric tests.

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R12 Technical Analysis

➤ Technical Analysis

- the principles of technical analysis, its applications, and its underlying assumptions
- Types of charts
- the uses of trend
- Common chart patterns
- Common analysis indicators
- the use of cycles

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R12 Technical Analysis

➤ Principles:

- Prices are determined by the interaction of supply and demand.
- Only participants who actually trade affect prices, and better-informed participants tend to trade in greater volume.
- Price and volume reflect the collective behavior of buyers and sellers.

➤ Assumptions:

- Market prices reflect both rational and irrational investor behavior.
 - ✓ Investor behavior is reflected in trends and patterns that trend to repeat and can be identified and used for forecasting prices.
 - ✓ Efficient markets hypothesis dose not hold.

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R12 Technical Analysis

➤ The differences among technicians, fundamentalists and Efficient market followers.

- Fundamental analysis of a firm attempts to determine the intrinsic value of an asset by using the financial statements and other information.
- Technical analysis uses only the firm's share price and trading volume data, and it is not concerned with identifying buyers' and sellers' reasons for trading, but only with the trades that have occurred.
- Fundamentalists believe that prices react quickly to changing stock values, while technicians believe that the reaction is slow. Technicians look for changes in supply and demand, while fundamentalists look for changes in value.

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R12 Technical Analysis

➤ Advantages of technical analysis:

- Actual price and volume data are observable.
- Technical analysis itself is objective (although require subjective judgment), while much of the data used in fundamental analysis is subject to assumptions or restatements.
- It can be applied to the prices of assets that do not produce future cash flows, such as commodities.
- It can also be useful when financial statement fraud occurs.

➤ Disadvantage:

- The usefulness is limited in markets where price and volume data might not truly reflect supply and demand, such as in illiquid markets and in markets that are subject to outside manipulation.

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R12 Technical Analysis

2015.12 (1) 2015.06 (1)

➤ Charts of price and volume are used to analyze asset prices and overall market movement.

- Horizontal axis: usually time interval (daily, weekly, monthly)
- Vertical axis: Price

➤ **Types of charts:**

- Line charts
- Bar charts
- Candlestick charts

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R12 Technical Analysis

Figure 1: Line Chart



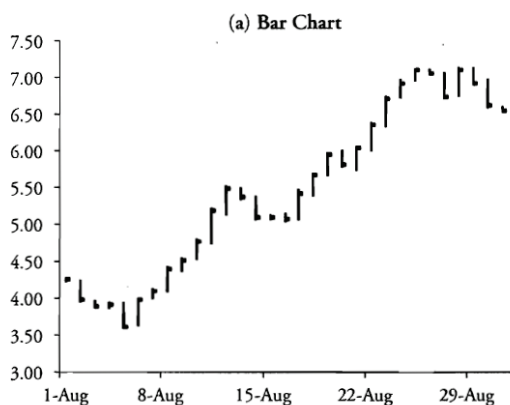
➤ **Line Charts** are the simplest technical analysis charts. They show closing prices for each periods as a continuous line.

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R12 Technical Analysis



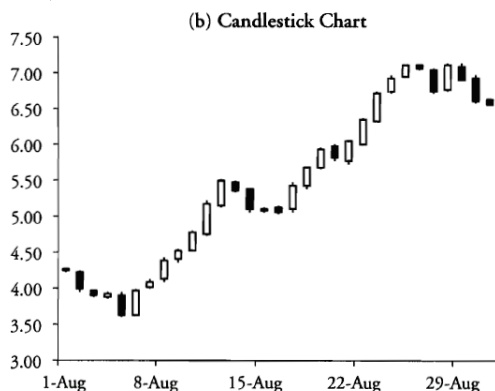
➤ **Bar charts** add the high and low prices for each trading period and often include the opening price and closing price as well.

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R12 Technical Analysis



➤ **Candlestick charts** use the same data as bar charts but display a box bounded by the opening and closing prices.

- Box is clear: closing price > opening price;
- Box is filled: closing price < opening price

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R12 Technical Analysis

2014.06 (1)

➤ Common chart patterns.

- Reversal patterns
 - ✓ For uptrend: Head-and shoulders pattern, Double top and triple top
 - ✓ For downtrend: inverse head-and shoulders pattern, Double bottom, and triple bottom
- Continuation patterns
 - ✓ Triangles
 - ✓ Rectangles

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R12 Technical Analysis

2015.12 (2) 2015.06 (1)
2014.06 (1)

➤ Common analysis indicators

- Price-based
 - ✓ Moving average lines
 - ✓ Bollinger bands
- Momentum oscillators
 - ✓ Rate of change oscillator
 - ✓ Relative Strength Index
 - ✓ Moving average convergence/divergence
 - ✓ Stochastic oscillator
- Sentiment
 - ✓ Put/call ratio
 - ✓ Volatility Index
 - ✓ Margin debt
 - ✓ Short interest ratio
- Flow of funds
 - ✓ Short-term trading index
 - ✓ Margin debt
 - ✓ Mutual fund cash position
 - ✓ New equity issuance

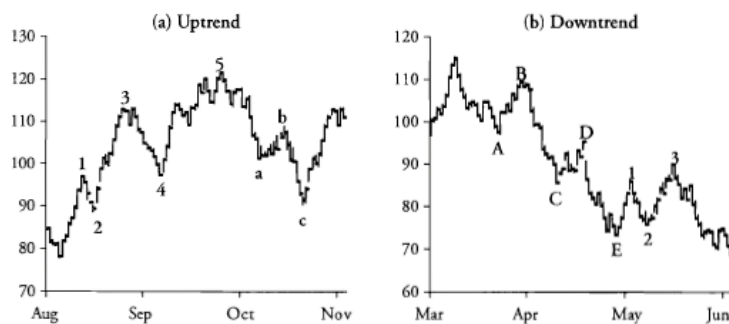
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R12 Technical Analysis

Figure 9: Elliott Wave Patterns



➤ **Prevailing up trend:** upward moves in prices consist of 5 waves and downward moves occur in 3 waves

➤ **Prevailing down trend:** downward moves in prices consist of 5 waves and upward moves occur in 3 waves

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It's not the end but just the beginning.

Life is short. If there was ever a moment to follow your passion and do something that matters to you, that moment is now.

生命苦短，如果你有一个机会跟随自己的激情去做你认为重要的事，那么这个机会就是现在。

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CFA一级培训项目

Portfolio Management



单晨玮

金程教育资深培训师

Topic Weightings in CFA Level I

| Session NO. | Content | Weightings |
|---------------------|----------------------------------|------------|
| Study Session 1 | Ethics & Professional Standards | 15 |
| Study Session 2-3 | Quantitative Analysis | 12 |
| Study Session 4-6 | Economics | 10 |
| Study Session 7-10 | Financial Reporting and Analysis | 20 |
| Study Session 11 | Corporate Finance | 7 |
| Study Session 12 | Portfolio Management | 7 |
| Study Session 13-14 | Equity Investment | 10 |
| Study Session 15-16 | Fixed Income | 10 |
| Study Session 17 | Derivatives | 5 |
| Study Session 18 | Alternative Investments | 4 |

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Framework of Portfolio Management

➤ SS 12 — Portfolio Management

- R41 Portfolio Management: An Overview
- R42 Risk Management: An Introduction
- R43 Portfolio Risk and Return: Part I
- R44 Portfolio Risk and Return: Part II
- R45 Basic of Portfolio Planning and Construction

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Portfolio Risk and Return: Part I

2015.06 (2)

➤ An individual investment:

● Expected Return
$$E(R) = \sum_{i=1}^n P_i R_i = P_1 R_1 + P_2 R_2 + \cdots + P_n R_n$$

● Variance of Return
$$\text{Var} = \sigma^2 = \sum_{i=1}^n [R_i - E(R)]^2 P_i$$

● Standard Deviation of Return
$$\text{SD} = \sigma = \sqrt{\sum_{i=1}^n [R_i - E(R)]^2 P_i}$$

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Portfolio Risk and Return: Part I

2015.06 (1)

➤ Covariance

$$\text{Cov}_{1,2} = \sum_{i=1}^n P_i [R_{i,1} - E(R_1)][R_{i,2} - E(R_2)]$$

➤ Correlation

$$\rho_{1,2} = \frac{\text{Cov}_{1,2}}{\sigma_1 \sigma_2} \quad \text{Cov}_{1,2} = \rho_{1,2} \sigma_1 \sigma_2$$

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Portfolio Risk and Return: Part I

2015.12 (3) 2015.06 (2)

2014.12 (1) 2014.06 (2)

➤ The portfolio standard deviation formula

- The risk of a portfolio of risky assets depends on the asset weights and the standard deviations of the assets returns, and crucially on the correlation (covariance) of the asset returns.

- The lower the correlation between the returns of the stocks in the portfolio, all else equal, the greater the diversification benefits.

- Two-asset portfolio:

$$\sigma_p^2 = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \text{COV}_{1,2}$$

$$\sigma_p^2 = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \sigma_1 \sigma_2 \rho_{1,2}$$

$$\sigma_p = \sqrt{\sigma_p^2} = \sqrt{\sum_{i=1}^n w_i^2 \sigma_i^2 + \sum_{i=1}^n \sum_{j=1}^n w_i w_j \text{Cov}_{i,j}}$$

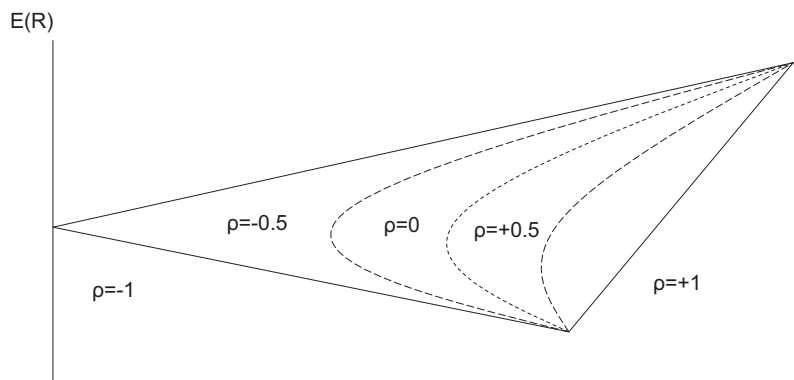
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Portfolio Risk and Return: Part I

➤ Risk and return for different values of correlation



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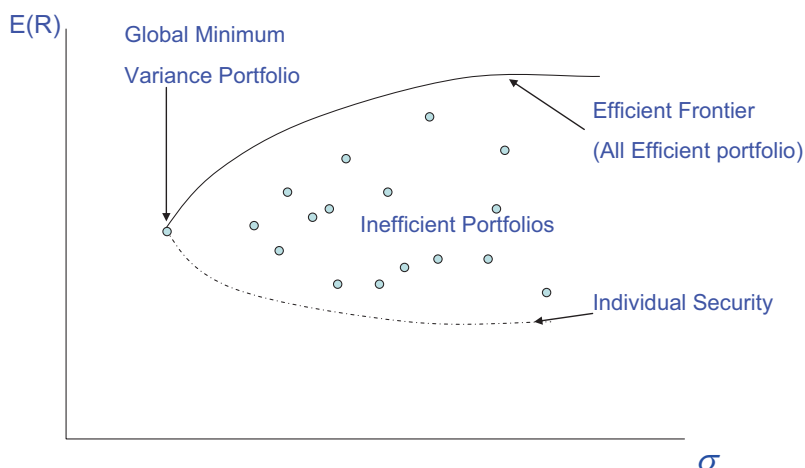


Portfolio Risk and Return: Part I

2015.06 (1)

2014.06 (1)

➤ The minimum-variance and efficient frontiers of risky assets and the global minimum-variance portfolio.



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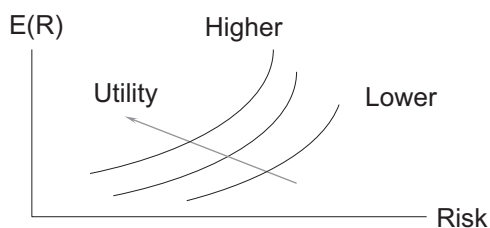
Portfolio Risk and Return: Part I

2015.12 (1) 2015.06 (1)

2014.06 (1)

➤ Risk aversion

- Refers to the fact that individuals prefer less risk to more risk.
- Risk-averse investors:
 - ✓ Prefer lower to higher risk for a given level of expected returns
 - ✓ Will only accept a riskier investment if they are compensated in the form of greater expected return



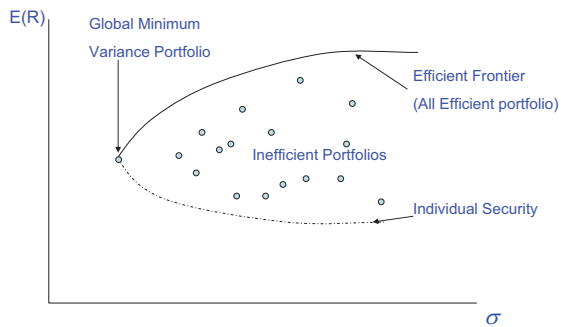
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Portfolio Risk and Return: Part I

- The optimal portfolio for an investor
 - At the point of where an investor's (highest) risk-return indifference curve is tangent to the efficient frontier.



- Optimal portfolio
 - The highest indifference curve that is tangent to the efficient frontier
 - Different investors may have different optimal portfolios

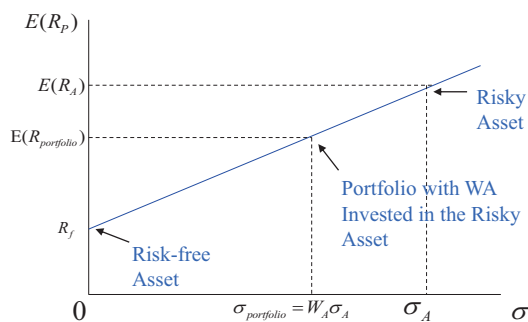
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Portfolio Risk and Return: Part II

- The implications of combining a risk-free asset with a portfolio of risky assets.



$$E(R_p) = W_A E(R_A) + W_B E(R_B)$$

$$\sigma_p = \sqrt{W_A^2 \sigma_A^2 + W_B^2 \sigma_B^2 + 2W_A W_B \rho_{AB} \sigma_A \sigma_B}$$

$$\sigma_p = \sqrt{W_A^2 \sigma_A^2} = W_A \sigma_A$$

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Portfolio Risk and Return: Part II

2014.06 (2)

The capital allocation line (CAL) and the capital market line (CML).

- Two-fund separation theorem:
 - Combining a risky portfolio with a risk-free asset
 - All investors' optimum portfolios will be made up of some combination of an optimal portfolio of risky assets and the risk-free asset.
- CAL
 - The line representing these possible combinations of risk-free assets and the optimal risky asset portfolio.

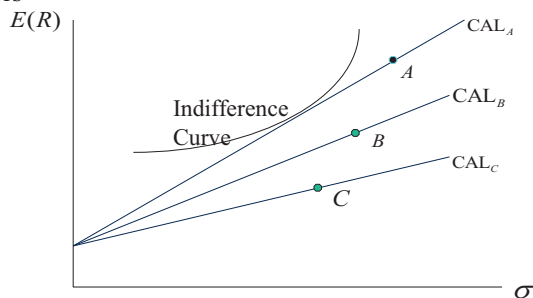
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Portfolio Risk and Return: Part II

- Risky Portfolios and Their Associated Capital Allocation Lines for Different investors



- If each investor has different expectations about the expected returns of, standard deviations of, or correlations between risky asset returns, each investor will have a different optimal risky asset portfolio and a different CAL

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Portfolio Risk and Return: Part II

- The Market Portfolio:

- Is the tangent point where the CML touches the Markowitz efficient frontier.
- Consists of every risky assets
- The weights on each asset are equal to the percentage of the market value of the asset to the market value of the entire market portfolio.

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Portfolio Risk and Return: Part II

2015.12 (1)

2014.12 (3)

- Capital market line

- When investors share identical expectations about the mean returns, variance of returns, and correlations of risky assets, the CAL for all investors is the same and is known as the capital market line (CML):

$$E(R_p) = R_F + \frac{E(R_M) - R_F}{\sigma_M} \sigma_p$$

- Explanation of the CML

- Investment using CML follow a passive investment strategy (i.e., invest in an index of risky assets that serves as a proxy for the market portfolio and allocate a portion of their investable assets to a risk-free asset.)
- Borrowing portfolio and lending portfolio
- Difference between the CML and the CAL

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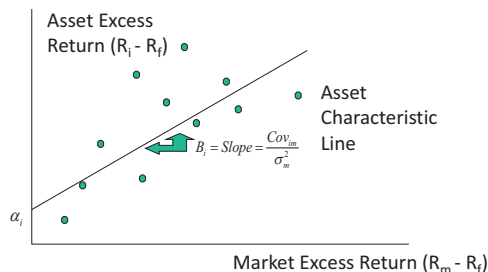


Portfolio Risk and Return: Part II

- Unsystematic risk (or unique, diversifiable, firm-specific risk): 2015.12 (1)
2014.06 (1)
- The risk that disappears in the portfolio construction process
- Systematic risk (or market risk):
- The risk that is left cannot be diversified away.
 - Total risk = systematic risk + unsystematic risk
- Beta: the sensitivity of an asset's return to the return on the market index in the market model.

$$\beta_i = \frac{Cov_{i,mkt}}{\sigma_{mkt}^2} = \left(\frac{\sigma_i}{\sigma_{mkt}} \right) \times \rho_{i,mkt}$$

2015.12 (2) 2015.06 (2)
2014.12 (1)



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Portfolio Risk and Return: Part II

2014.12 (1)
2014.06 (1)

- Assumptions of the CAPM
- Investors are risk-averse, utility-maximizing, rational individuals.
 - Markets are frictionless, including no transaction costs and no taxes.
 - Investors plan for the same single holding period.
 - Investors have homogeneous expectations or beliefs.
 - All investments are infinitely divisible.
 - Investors are price takers.

17-38

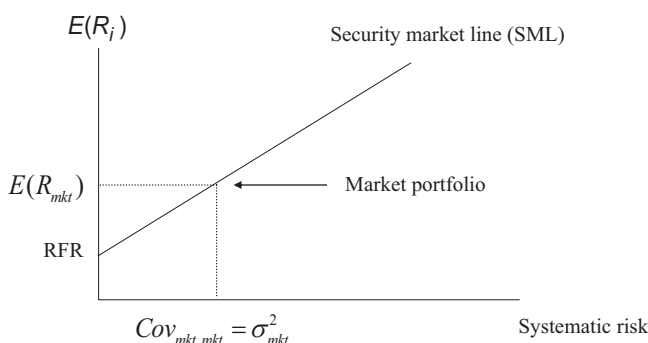
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Portfolio Risk and Return: Part II

2014.12 (1)
2014.06 (2)

➤ Capital Asset Pricing Model



➤ The Equation of SML: $E(R_i) = R_f + \beta_i [E(R_M) - R_f]$

18-38

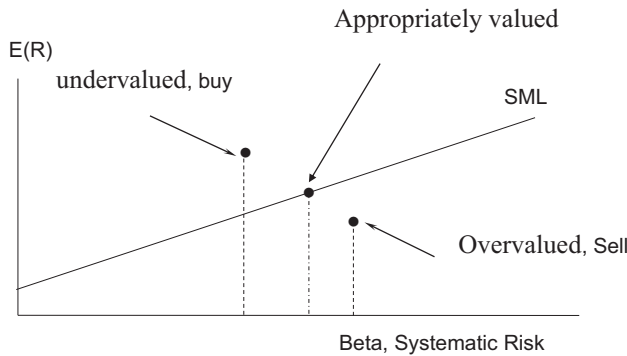
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Portfolio Risk and Return: Part II

2015.06 (1)

➤ How to judge if a stock is properly valued



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Portfolio Risk and Return: Part II

2015.12 (1) 2015.06 (1)
2014.12 (1)

➤ Differences between the SML and the CML

| | SML | CML |
|-----------------|--|---|
| Measure of risk | Uses systematic risk (non-diversifiable risk) | Uses standard deviation (total risk) |
| Application | Tool used to determine the appropriate expected (benchmark) returns for securities | Tool used to determine the appropriate asset allocation (percentages allocated to the risk-free asset and to the market portfolio) for the investor |
| Definition | Graph of the capital asset pricing model | Graph of the efficient frontier |
| Slope | Market risk premium | Market portfolio Sharpe ratio |

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Portfolio Risk and Return: Part II

2014.12 (1)
2014.06 (1)

➤ Sharpe Ratio

$$\text{Sharpe ratio} = \frac{R_p - R_f}{\sigma_p}$$

➤ M-squared (M^2)

$$M^2 = (R_p - R_f) \frac{\sigma_M}{\sigma_p} - (R_M - R_f)$$

➤ Treynor measure

$$\text{Treynor measure} = \frac{R_p - R_f}{\beta_p}$$

➤ Jensen's alpha

$$\alpha_p = (R_p - R_f) - \beta_p (R_M - R_f)$$

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Portfolio Management: An Overview

2015.12 (1)
2015.06 (1)

➤ Characteristics of different types of investors

| Investor | Risk Tolerance | Investment Horizon | Liquidity Needs | Income Needs |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Individuals | Depends on individual | Depends on individual | Depends on individual | Depends on individual |
| DB pensions | High | Long | Low | Depends on age |
| Banks | Low | Short | High | Pay interest |
| Endowments | High | Long | Low | Spending level |
| Insurance | Low | Long—life Short—P&C | High | Low |
| Mutual funds | Depends on fund | Depends on fund | High | Depends on fund |

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Portfolio Management: An Overview

2015.06 (1)
2014.06 (1)

➤ Planning step:

- Analysis of the investor's risk tolerance, return objectives, time horizon, tax exposure, liquidity needs, income needs, unique circumstances;
- IPS: details the investor's investment objectives and constraints; specify an objective benchmark; updated at least every few years and anytime the investor's objectives or constraints change significantly.

➤ Execution step: asset allocation; top-down analysis & bottom-up

➤ Feedback step:

- monitor and rebalance the portfolio;
- Measure portfolio performance.

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Basic of Portfolio Planning and Construction

➤ The need for a policy statement

- Understand and articulate realistic investor goals, needs and risk tolerance
- Ensure that goals are realistic
- Provide an objective measure of portfolio performance

➤ Major components of IPS

- Description of client
- Statement of the purpose
- Statement of duties and responsibilities
- Procedures to update IPS and to respond to various possible situations
- Investment objectives
- Investment constraints
- Investment guidelines
- Evaluation of performance
- Appendices: information on asset allocation

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Basic of Portfolio Planning and Construction

- Investment objectives: risk and return 2015.12 (1) 2015.06 (1)
2014.12 (1)
- Risk objective

| Situation | | Risk tolerance |
|-----------------------|--------------------------------|----------------------------|
| willingness > ability | | ability (education) |
| willingness < ability | return objective = willingness | willingness (reevaluation) |
| | return objective = ability | ability (education) |

- Return objectives
 - ✓ Return measurement: total return, inflation-adjusted return, after-tax return
 - ✓ Total return perspective: balance between capital gains and income
 - ✓ Stated return desire vs. Required return
 - ✓ Consistent with risk objective

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Basic of Portfolio Planning and Construction

2015.12 (1)

- Investment constraints
- Liquidity—for cash spending needs (anticipated or unexpected)
 - Time horizon—the time between making an investment and needing the funds
 - Tax concerns—the tax treatments of various accounts, and the investor's marginal tax bracket
 - Legal and regulatory factors—restrictions on investments in retirement, personal, and trust accounts
 - Unique needs and preferences—constraints because of investor preferences or other factors not already considered

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Basic of Portfolio Planning and Construction

2015.12 (1)

2014.12 (1)

2014.06 (1)

- Strategic asset allocation:
- combine the IPS and capital market expectations to formulate weightings on acceptable asset classes
 - Specify the percentage allocations to the included asset classes
 - Correlations within the class & correlations between asset classes
- Tactical asset allocation: a manager who varies from strategic asset allocation weights in order to take advantage of perceived short-term opportunities. Depend on:
- The manager's ability to identify short-term opportunities in specific asset classes;
 - The existence of such short-term opportunities.
- Security selection: deviation from index weights on individual securities within an asset class. Depend on:
- The manager's skill
 - The opportunities with in a particular asset class.

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Risk Management: An Introduction

➤ Risk

- Exposure to uncertainty
- Many decision makers focus on return, which is not something that is easily controlled, as opposed to risk, or exposure to risk, which may actually be managed or controlled

➤ Risk exposure

- The extent to which an entity's value may be affected through sensitivity to underlying risks.

➤ Risk management

- Risk management is the process by which an organization or individual **defines** the level of risk to be taken, **measures** the level of risk being taken, and **adjusts** the latter toward the former; with the goal of **maximizing** the company's or portfolio's value or the individual's overall satisfaction, or utility.
- It comprises all the decisions and actions needed to best achieve organizational or personal objectives while **bearing a tolerable level of risk**.
- **Not about minimizing risk.**

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Risk Management: An Introduction

➤ Risk management framework

- Risk governance
- Risk identification and measurement
- Risk infrastructure
- Defined policies and processes
- Risk monitoring, mitigation, and management
- Communications
- Strategic analysis or integration

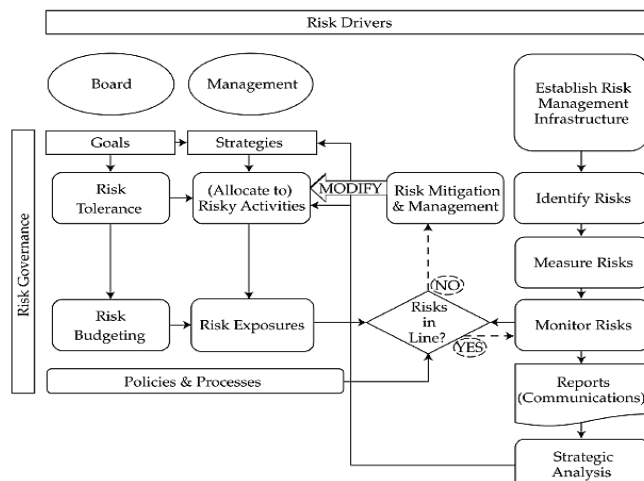
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Risk Management: An Introduction

Exhibit 1. The Risk Management Framework in an Enterprise Context



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Risk Management: An Introduction

➤ Risk governance

- Risk governance is the foundation for risk management.
- **Risk governance** refers to senior management's determination of the **risk tolerance** of the organization, the elements of its optimal **risk exposure strategy**, and the framework for oversight of the risk management function.
- Employing a risk management committee, along with a chief risk officer (CRO), are hallmarks of a strong risk governance framework.
 - ✓ **Risk management committee** provides top decision makers with a forum for regularly considering risk management issues.

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Risk Management: An Introduction

➤ Risk tolerance

- At the governance level, the duty is generally not to select these activities—a job that usually falls to management—but to **establish the organization's risk appetite**.
 - ✓ Certain risks or levels of risks may be deemed acceptable, other risks deemed unacceptable, and in the middle are risks that may be pursued in a risk-limited fashion.
 - ✓ Said differently, risk tolerance identifies the extent to which the entity is willing to experience losses or opportunity costs and to fail in meeting its objectives
- When analyzing risk tolerance, management should examine risks that may exist within the organization as well as those that may arise from outside. (**"inside" view and "outside" view**)
- The risk tolerance should be chosen and communicated **before** a crisis, and will serve as the high-level guidance for management in its strategic selection of risks.
- If a company has the **ability to adapt quickly to adverse events** may allow for a higher risk tolerance.

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Risk Management: An Introduction

- **Risk budgeting** is the process of allocating firm resources to assets (or investments) by considering their various risk characteristics and how they combine to meet the organization's risk tolerance.
 - The process of risk budgeting forces the firm to consider **risk tradeoffs**.
 - The **goal** is to allocate the overall amount of acceptable risk to the mix of assets or investments that have the greatest expected returns over time. (**The return per unit of risk is the highest.**)
- The risk budget may be a **single metric**, such as portfolio beta, value at risk (VaR), portfolio duration, or returns variance.
- A risk budget may be constructed based on **categories of investments**, such as domestic equities, domestic debt securities, international equities, and international debt securities.
- Another way to allocate a risk budget is to identify **specific risk factors**, such as interest rate risk, equity market risk, and foreign exchange rate risk.

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Risk Management: An Introduction

- **Financial risks** refer to the risks that arise from events occurring in the financial markets. Examples are:
 - **Market risk**
 - **Credit risk**
 - **Liquidity risk**: Liquidity risk could also be called transaction cost risk and is most associated with a **widening bid-ask spread**.
- **Non-financial risks** arise from actions within an entity or from external origins, such as the environment, the community, regulators, politicians, suppliers, and customers. Examples are:
 - **Operational risk**
 - **Solvency risk**
 - **Regulatory risk**
 - **Governmental or political risk (including tax risk)**
 - **Legal risk**
 - **Model risk**
 - **Tail risk**
 - **Accounting risk**
- **Individuals** face many of the same organizational risks outlined here but also face **health risk, mortality or longevity risk, and property and casualty risk**.

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R42 Risk Management: An Introduction

- **Risk drivers** are the fundamental global and domestic **macroeconomic and industry factors** that create risk.
- **Metrics**
 - **Standard deviation** is a measure of the volatility of asset prices and interest rates. Standard deviation may not be the appropriate measure of risk for non-normal probability distributions, especially those with negative skew or positive excess kurtosis (fat tails).
 - **Beta** measures the market risk of equity securities and portfolios of equity securities. This measure considers the risk reduction benefits of diversification and is appropriate for securities held in a well-diversified portfolio.
 - **Duration** is measure of the price sensitivity of debt securities to changes in interest rates.
 - **Derivative measures**, such as delta, gamma, vega, and rho.

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R42 Risk Management: An Introduction

- **Tail measures** such as value at risk (VaR), CVaR and expected loss given default (LGD).
 - ✓ **VaR** is the **minimum loss** over a period that will occur with a specific probability.
 - ✓ **CVaR** is the expected value of loss, given that the loss exceeds a minimum amount. (calculated as the probability-weighted average loss for all losses expected to exceed a minimum amount)
- Subjective and market-based estimates of risk
 - Two methods of risk assessment that are used to supplement measures such as VaR and CVaR are **stress testing** and **scenario analysis**.
 - ✓ **Stress testing** examines the effects of a specific (usually extreme) change in a key variable such as an interest rate or exchange rate.
 - ✓ **Scenario analysis** refers to a similar what-if analysis of expected loss but incorporates changes in multiple inputs.

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R42 Risk Management: An Introduction

➤ Modifying risk exposures

- Risk management does not seek to eliminate all risks. The goal is to retain the optimal mix of risks for the organization.

➤ Methods of risk modification:

- **Risk prevention and avoidance**
 - ✓ Not engage in the activity with the uncertain outcome.
- **Risk acceptance:** self-insurance and diversification
 - ✓ **Self-insurance** is obtained by setting aside sufficient capital to cover losses.
 - ✓ Another form of accepting risk, but doing so in the most efficient manner possible, is **diversification**.
- **Risk transfer** (insurance)
 - ✓ Risk transfer is the process of passing on a risk to another party, often, but not always, in the form of an **insurance policy**.
- **Risk shifting** (derivatives)
 - ✓ Whereas risk transfer refers to actions taken that pass the risk on to other parties, risk shifting refers to actions that change the distribution of risk outcomes. Risk shifting generally involves **derivatives** as the risk modification vehicle.

- The determinants of which method is best for modifying risk are the benefits weighed against the costs.

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It's not the end but just the beginning.

If you have people you love, allow them to be free beings. Give and don't expect. Advise, but don't order. Ask, but never demand. It might sound simple, but it is a lesson that may take a lifetime to truly practice. It is the secret to true Love. To truly practice it, you must sincerely feel no expectations from those who you love, and yet an unconditional caring.

如果你有爱的人，允许他们自由随意的存在。给予而不指望；建议而不命令；请求而不要求；可能听起来简单，但这需要一辈子去实践。这就是真爱的秘诀。真正去实践它，你必须对那些你爱的人没有期望，并给予无条件的关爱。

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CFA一级培训项目

Economics



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Topic Weightings in CFA Level I

| | | |
|---------------------|---------------------------------|-----|
| Study Session 1 | Ethics & Professional Standards | 15 |
| Study Session 2-3 | Quantitative Methods | 12 |
| Study Session 4-6 | Economic Analysis | 10 |
| Study Session 7-10 | Financial Statement Analysis | 20 |
| Study Session 11 | Corporate Finance | 8 |
| Study Session 12 | Portfolio Management | 5 |
| Study Session 13-14 | Equity Analysis | 10 |
| Study Session 15-16 | Fixed Income Analysis | 12 |
| Study Session 17 | Derivative Investments | 5 |
| Study Session 18 | Alternative Investments | 3 |
| | Total: | 100 |

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Framework of Economics

➤ SS 4 Microeconomic Analysis

- R13 demand and supply: introduction
- R14 demand and supply: consumer demand introduction
- R15 demand and supply: the firm
- R16 the firm and the market structure

➤ SS 5 Macroeconomic Analysis

- R17 aggregate output, price, and economic growth
- R18 understand business cycles
- R19 monetary and fiscal Policy

➤ SS 6 Economics in a Global Context

- R20 international trade and capital flow
- R21 currency exchange rate

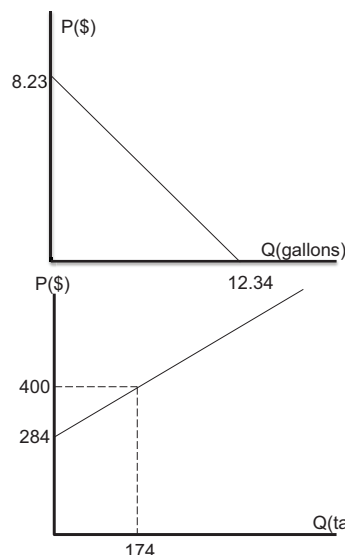
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Demand and Supply

2015.12 (1) 2015.06 (1)
2014.06 (2)



Demand function: $Q_{\text{gas}} = 12.34 - 15P_{\text{gas}}$,

Inverse Demand function: $P_{\text{gas}} = 8.23 - 0.667Q_{\text{gas}}$

Supply function: $Q_{\text{tables}} = -426 + 1.5P_{\text{tables}}$

Inverse supply function: $P_{\text{tables}} = 284 + 0.667Q_{\text{tables}}$

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Shifts in and Movements along Demand and Supply Curves

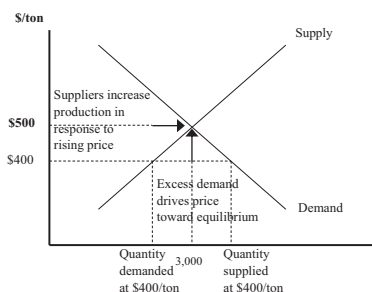
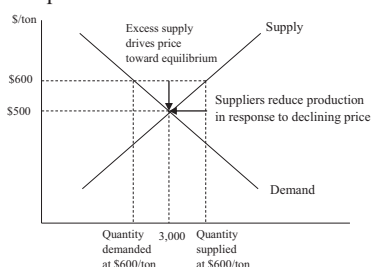
- **Movements along demand and supply curves.**沿着需求（供给）曲线移动
 - A change in the market price that simply increases or decreases the quantity supplied or demanded is represented by a movement along the curve.
- **Shifts in demand and supply curves.**需求（供给）曲线本身发生移动
 - A change in one of the independent variables other than price will result in a shift of the curve itself.

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Movement toward Equilibrium

- If the price is above its equilibrium level, the quantity willingly supplied exceeds the quantity consumers are willing to purchase, and we have excess supply. Suppliers willing to sell at lower price will offer those prices to consumers, driving the market price down towards the equilibrium level.
- If the market price is below its equilibrium level, the quantity demanded at that price exceeds the quantity supplied, and we have excess demand. Consumers will offer higher prices to compete for the available supply, driving the market price up towards its equilibrium level.



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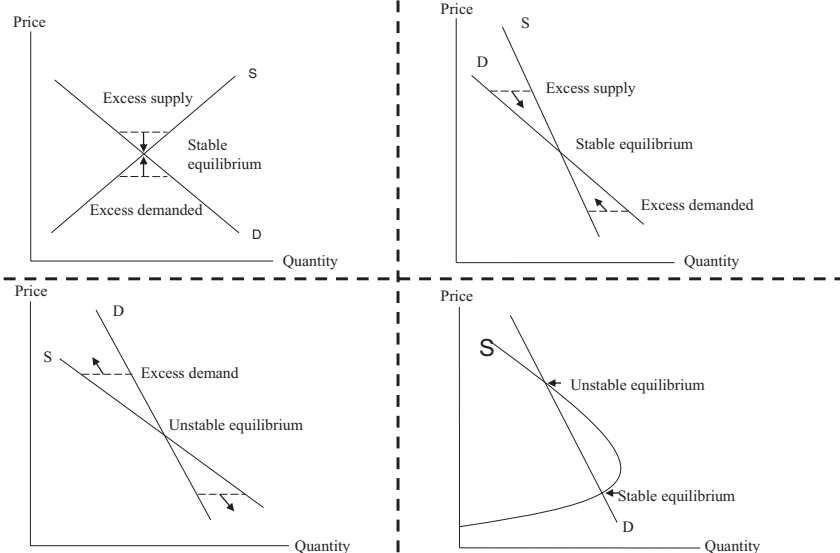
Stable and Unstable Equilibrium

- An equilibrium is termed **stable** when there are forces that move price and quantity back towards equilibrium values when they deviate from those values
 - as long as supply curve cuts through the demand curve from above, the equilibrium will be stable
- If the supply curve is less steeply sloped than the demand curve, and prices above (below) equilibrium will tend to get further from equilibrium. We refer to such an equilibrium as **unstable**.

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Stable and Unstable Equilibrium



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Types of Auctions

- Auction is an alternative to markets for determining an equilibrium price.
- Types of Auction: Common value auction vs. Private value auction
 - **common value auction**
 - ✓ value of the item to be auctioned will be the same to any bidder
 - ✓ Winning bidder mostly overestimate the value (**winner's curse**)
 - **private value auction:** The value that each bidder places on an item is the value it has to him, and we assume that no bidder will bid more than that. (e.g., art, collectibles)
- Common type of auctions:
 - ascending price auction (English auction)
 - sealed bid auction
 - ✓ the first sealed bid auction
 - ✓ second price sealed bid auction (Vickrey auction)
 - descending price auction (Dutch auction)
- **Single price auction** is used in **selling U.S. Treasury securities**. 2015.06 (1) 2014.06 (1)
 - But bidders may also submit a noncompetitive bid. Such a bid indicates that those bidders will accept the amount of Treasuries indicated at the price determined by the auction, rather than specifying a maximum price in their bids.

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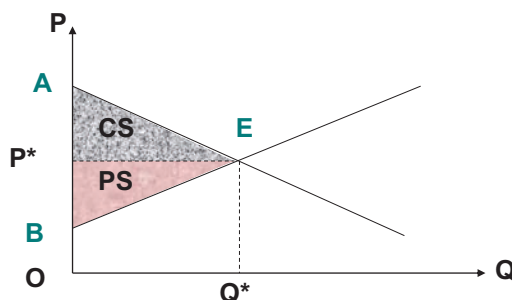
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Consumer Surplus, Producer Surplus, and Total Surplus

2015.12 (1)

2014.12 (1)

- The difference between the total value to consumers of the units of a good that they buy and the total amount they must pay for those units is called **consumer surplus**
- **Producer surplus** is the excess of the market price above the opportunity cost of production
- **Total surplus** = consumer surplus + producer surplus



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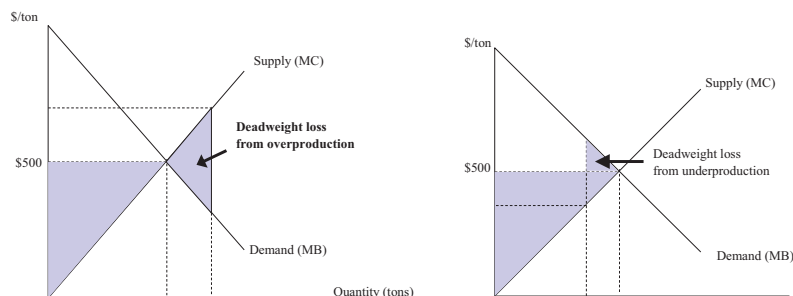
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Deadweight Loss

2014.06 (1)

➤ Deadweight Loss

- The reduction in consumer and producer surplus due to underproduction or overproduction is called a **deadweight loss**.



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Obstacles to Efficiency

➤ Obstacles to Efficiency

- Price controls: price ceiling (underproduction, e.g. rent control) and price floor (overproduction, e.g. minimum wage)
- Tax: buyers pay a higher price, sellers receive a lower price
- Subsidies: overproduction
- Quotas: underproduction
- Monopoly: underproduction
- External costs: overproduction
- External benefits: underproduction
- Public goods: underproduction
- Common resources: overproduction

2015.06 (1)

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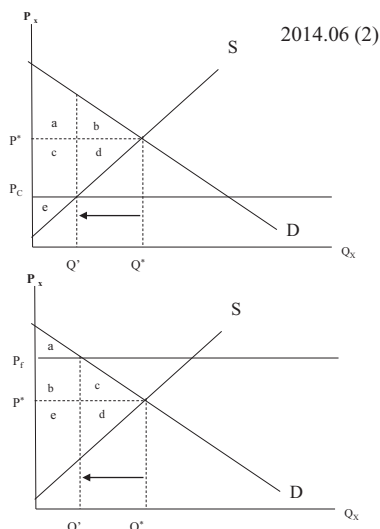


Price Ceiling and Price Floor

➤ A **price ceiling** is an upper limit on the price which a seller can charge. If the ceiling is above the equilibrium price, it will have no effect.

➤ **Price floor** is a minimum price that a buyer can offer a good, service, or resource. If the price floor is below the equilibrium price, it will have no effect on equilibrium price and quantity.

- The **minimum wage** in the United States is an example of a price floor
- The result is increased unemployment because even when there are workers willing to work at a wage lower than the minimum, firms cannot legally hire them.



2014.06 (2)

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Impact of Taxes

- Actual and Statutory Incidence of a Tax
 - **Statutory incidence** refers to who is legally responsible for paying the tax.
 - The **actual incidence** of a tax refers to who actually bears the cost of the tax through an increase in the price paid (buyers) or decrease in the price received (sellers)
- Tax on producers:
 - Statutory incidence: sellers
 - Actual incidence: sellers and buyers
- Tax on buyers:
 - Statutory incidence: buyers
 - Actual incidence: buyers and sellers

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Price Elasticity of Demand

- **Price elasticity** is a measure of the responsiveness of the quantity demanded to a change in price.
 - The formula used to calculate the price elasticity of demand is :

$$\text{price elasticity of demand} = \frac{\text{percent change in quantity demand}}{\text{percent change in price}} = \frac{\Delta Q / Q}{\Delta P / P}$$

where:

$$\text{percent change} = \frac{\text{change in value}}{\text{average value}} = \frac{\text{ending value} - \text{beginning value}}{\left(\frac{\text{ending value} + \text{beginning value}}{2} \right)}$$

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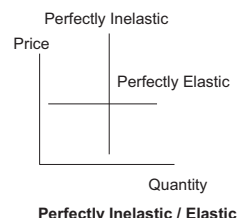
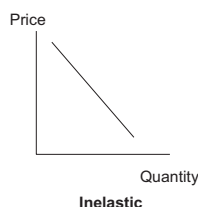
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Price Elasticity of Demand

2014.06 (1)

- If a *small* percentage price change results in a *large* percentage change in quantity demanded, the demand for that good is said to be **highly elastic**. The absolute value of price elasticity is greater than one.
- If a *large* percentage price change results in a *small* percentage change in quantity demanded, demand is **relatively inelastic**. The absolute value of price elasticity is less than one.
- A **perfectly elastic** demand curve is horizontal, and its elasticity is infinite. If the price increases, quantity demanded goes to zero.
- A **perfectly inelastic** demand curve is vertical, and elasticity is zero. If the price changes, there will be no change in the quantity demanded.



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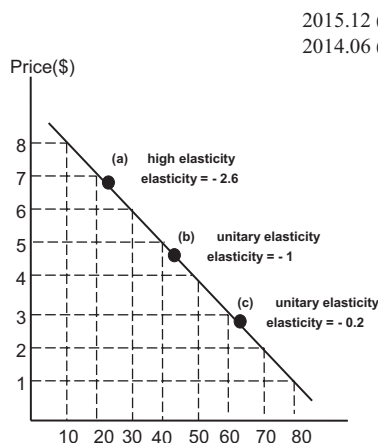
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Price Elasticity of Demand is Different Along a linear Demand Curve

➤ The relation between price elasticity of demand and total revenue.

- Total revenue is maximized at the price and quantity where demand is unit elastic (price elasticity = -1) and so decreases with both price increases or price decreases from that level.
- When price is in the elastic (inelastic) region of the demand curve, a price increase will decrease (increase) total revenue.



2015.12 (1)

2014.06 (1)

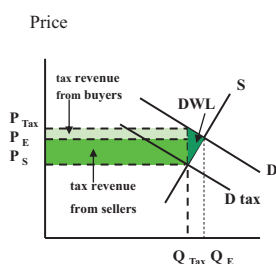
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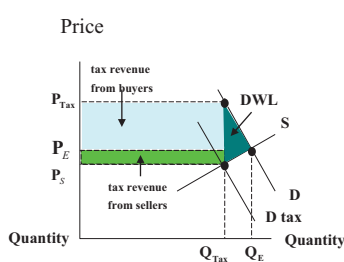
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Elasticity of Supply and Demand and Tax Incidence

(a) Inelastic Supply Curve



(b) Inelastic Demand Curve



2015.06 (1)

2014.12 (1)

- If the supply curve is less elastic, sellers will bear a higher tax burden. (Figure a)
- If the demand curve is less elastic, buyers will bear a higher tax burden. (Figure b)

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Factors that Influence the Elasticity of Demand

- **Availability of substitutes.** If good substitutes are available, a price increase in one product will induce consumers to switch to a substitute good.
- **Relative amount of income spent on the good.** When the portion of consumer budgets spent on a particular good is relatively small, demand for that good will tend to be relatively inelastic.
- **Time since the price change.** The price elasticity of demand for most products is greater in the long run than in the short run.

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Cross Elasticity

2015.06 (1)

- **Cross elasticity of demand** measures the change in the demand for a good in response to the change in price of a substitute or complementary good.

- The formula for calculating cross elasticity of demand is:

$$\text{cross elasticity of demand} = \frac{\text{percent change in quantity demanded}}{\text{percent change in price of substitute or complement}} = \frac{\Delta Q_A / Q_A}{\Delta P_B / P_B}$$

- Cross elasticity of demand is *positive* for *substitute goods*.
(Example: apple and pear)
- Cross elasticity of demand is *negative* for *complement goods*.
(Example: car and gas)

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Income Elasticity of Demand

- **Income elasticity of demand** measures the sensitivity of the quantity of a good or service demanded to a change in a consumer's income.

- The formula for income elasticity of demand is:

$$\text{income elasticity of demand} = \frac{\text{percent change in quantity demanded}}{\text{percent change in income}} = \frac{\Delta Q / Q}{\Delta I / I}$$

- **The application of Income elasticity**

- **Normal Goods**: positive income elasticity, demand rises with income. (> 0)
 - ✓ **Luxuries**: high positive elasticity, demand rises strongly with income. (> 1)
 - ✓ **Necessity goods**: normal but low elasticity (between $0 \sim 1$)
- **Inferior Goods**: negative income elasticity, demand falls with income (< 0)

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Consumer Choice Theory

2015.12 (1)
2015.06 (1)

➤ Axioms of the theory of consumer choice

- **Complete preferences**: $A > B$ or $A < B$ or $A = B$
- **Transitive preferences**: $A > B$ and $B > C \Rightarrow A > C$
- **Non-satiation**: “more is better”, $A+1 > A$

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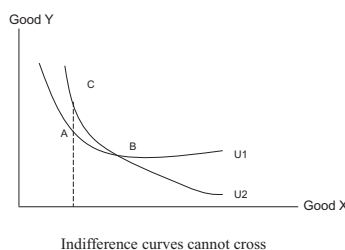
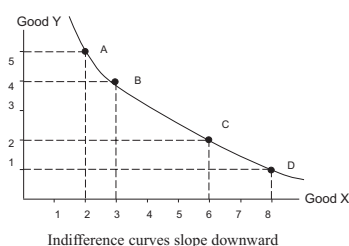


Indifference Curve

➤ **Indifference curve** represents all the combinations of two goods such that the consumer is entirely indifferent among them.

➤ **Characteristics of indifference curve**:

- Indifference curves for two goods slope downward
- Indifference curves cannot cross
- Indifference curves are convex towards the origin



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Marginal Rate of Substitution (MRS)

2014.12 (1)
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➤ **Marginal rate of substitution (MRS)**

- the rate at which the consumer is willing to give up one goods to obtain another goods, holding utility constant.
- $MRS_{XY} = -\Delta Y / \Delta X$
 - ✓ Example: $MRS_{XY} = 3$, increase 1 unit of Good X, have to give up 3 units of Good Y, holding utility constant.

➤ **the law of diminishing marginal rate of substitution**: as one moves down a (standardly convex) indifference curve, the marginal rate of substitution decreases (as measured by the absolute value of the slope of the indifference curve, which decreases).

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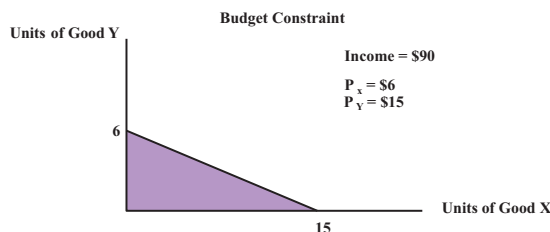
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Budget Constraints

2014.12 (1)

- **Budget constraint** can be constructed based on the consumer's income and the prices of the available goods.
- The **budget line** shows all combinations of Good X and Good Y that will just exhaust the consumer's income.
 - $P_X \cdot Q_X + P_Y \cdot Q_Y \leq I$
 - Slope of Budget constraint is negative
 - Slope of Budget constraint is the **price ratio**



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Consumer's Equilibrium

- **Consumer equilibrium**
- Utility is maximized, subject to the budget constraint
 - Tangency between budget constraint & the highest attainable indifference curve
 - At tangent point, MRS_{XY} (边际替代率, 消费者意愿) = Price ratio (相对价格, 市场意愿)

$$MRS_{XY} = -\frac{\Delta Y}{\Delta X} = \frac{MU_X}{MU_Y} = \frac{P_X}{P_Y}$$

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Substitution and Income Effects

2015.12 (1) 2015.06 (1)
2014.12 (1)

- **Substitution effect**
- When the price of Good X decreases, the relative price of Good X against other goods will decrease. Consumer equilibrium moves along the indifference curve, which leads to an increase in the demand of Good X.
- **Income effect**
- When the price of Good X decreases, consumer's real purchasing power will change. Real income increases, and budget constraint moves, which lead to a change in the demand of Good X.
- Income effect & Substitution effect共同作用决定需求量变化
- When decrease in the price of Good X:
- The substitution effect is positive, and the income effect is also positive—consumption of Good X will increase.
 - The substitution effect is positive, and the income effect is negative but smaller than the substitution effect—consumption of Good X will increase.
 - The substitution effect is positive, and the income effect is negative and larger than the substitution effect—consumption of Good X will decrease

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Normal Goods and Inferior Goods

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- **Normal good** is one for which the income effect is positive.
- **Inferior good** is one for which the income effect is negative.
- **Giffen goods** (吉芬商品):
 - Income effect (inferior goods) > Substitution effect
 - demand curve has positive slope
- **Veblen goods** (韦伯伦商品, Conspicuous goods):
 - Consumer can not truly value a good until the price is known.
 - Price is used by the consumer to signal the status in the society.
 - High price → high value → high demand quantity (extremely)
 - ✓ have a positively sloped demand curve (eg: Gucci bag) firstly
 - ✓ But when price increases, the slope may be negative.
- two important distinctions between Giffen goods and Veblen goods.
 - First, Giffen goods are inferior goods (negative income effect), while Veblen goods certainly are not.
 - Second, the existence of Giffen goods is theoretically supported by our rules of consumer choice, while the existence of Veblen goods is not.

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Accounting Profit, Economic Profit and Normal Profit

- **Accounting profit** may be referred to as net income, net profit, net earnings, or the “bottom line” (of the firm’s income statement).
 - Accounting profit = total revenue – total accounting (explicit) cost
- **Economic profit** is also referred to as abnormal profit. It is equal to accounting profit less implicit costs.
 - **Implicit costs** are the opportunity costs of resources supplied to the firm by its owners.
 - For private firms, these costs may include (1) the opportunity cost of owner-supplied capital and (2) the opportunity cost of the time and (3) entrepreneurial ability of the firm’s owners.
 - For publicly traded firms, implicit costs are typically only the opportunity cost of equity owners’ investment in the firm.
 - Economic profit = accounting profit – implicit opportunity costs
 - Or economic profit = total revenue – total economic costs
- **Normal profit** is the accounting profit that makes economic profit zero.
 - Accounting profit = economic profit + normal profit

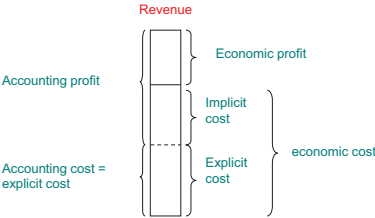
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Relationship of Accounting, Normal, and Economic Profit to Equity Value

| Relationship between Accounting Profit and Normal Profit | Economic Profit | Firm's Market Value of Equity |
|--|---|-------------------------------|
| Accounting profit > Normal profit | Economic profit > 0 and firm is able to protect economic profit over the long run | Positive effect |
| Accounting profit = Normal profit | Economic profit = 0 | No effect |
| Accounting profit < Normal profit | Economic profit < 0 implies economic loss | Negative effect |



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Total Revenue, Average Revenue, and Marginal Revenue

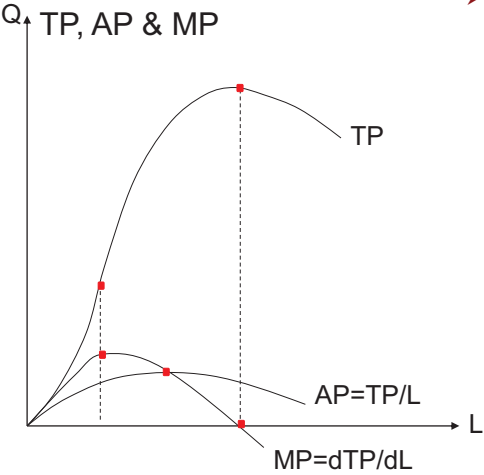
- **Total revenue (TR)** for any firm that charges a single price to all customers is calculated as price multiplied by quantity sold, or $TR=P*Q$.
- **Average revenue (AR)** is equal to total revenue divided by the quantity sold, $AR=TR/Q$.
- **Marginal revenue (MR)** is the increase in total revenue from selling one more unit of a good or service.
- **Under perfect competition**
 - The individual firm has virtually no impact on market price, price taker.
 - The individual seller faces a horizontal demand curve over relevant output ranges at the price level established by the market.
- **Under imperfect competition**
 - Firms face downward-sloping demand curve, price searchers.
 - Total revenue (TR) is maximized when $MR=0$.

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Law of Diminishing Returns



- **The law of diminishing returns** states that as more and more resources (such as labor) are devoted to a production process, they increase output but at an ever decreasing rate.

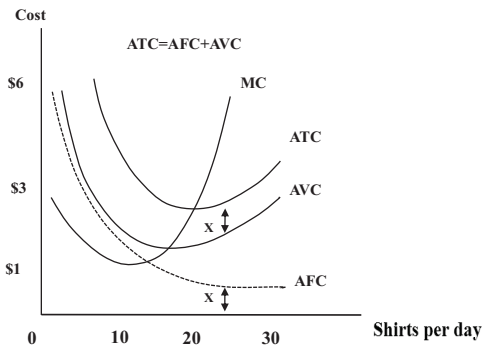
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Total, Average, Marginal, Fixed, and Variable Costs

Average and Marginal Costs



- (1) AFC slopes downward.
- (2) MC declines initially, then increases.
- (3) MC intersects AVC and ATC at their minimum points.

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Shutdown and Breakeven under Imperfect Competition

- Profit maximization occurs when
 - The difference between total revenue (TR) and total costs (TC) is the greatest;
 - Marginal revenue (MR) equals marginal cost (MC); ($MR=MC$) 2014.12 (1)
- Shutdown and breakeven point

| Revenue-Cost Relationship | Short-Run Decision | Long-Run Decision |
|---------------------------------|------------------------------|-------------------|
| $TR \geq TC$ | Stay in market | Stay in market |
| $TR > TVC$ but $TR < TFC + TVC$ | Stay in market | Exit market |
| $TR < TVC$ | Shut down production to zero | Exit market |

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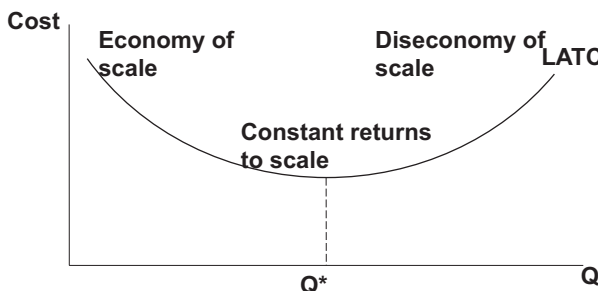
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Economies of Scale and Diseconomies of Scale

2014.12 (1)

- The downward sloping segment of the long-run average total cost curve indicates the economies of scale.
- The upward sloping segment of this long-run average total cost curve indicates that diseconomies of scale are present when average unit costs rise as the scale of the business



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Profit-maximizing Utilization of an Input

- For a firm with N productive inputs, cost minimization requires

$$\frac{MP_1}{P_1} = \frac{MP_2}{P_2} = \dots = \frac{MP_N}{P_N}$$

- 厂商可以通过对要素投入量的不断调整, 使得最后一单位的成本支出无论用来购买哪一种生产要素所获得的边际产量都相等, 从而实现既定成本条件下的最大产量

- The condition for cost minimization does not tell us how much of either input to use to maximize profit.

- Marginal revenue product (MRP) is the monetary value of the marginal product of an input.

- Based on the condition for the profit-maximizing utilization of each factor, $MRP_f = P_p$ for profit maximization, a firm must employ inputs in quantities

$$MRP = MP \times MR$$

$$\frac{MRP_1}{P_1} = \frac{MRP_2}{P_2} = \dots = \frac{MRP_N}{P_N} = 1$$

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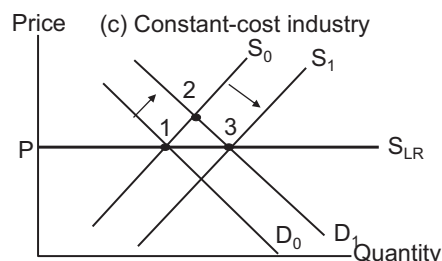
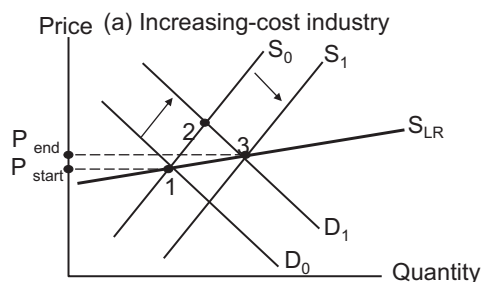
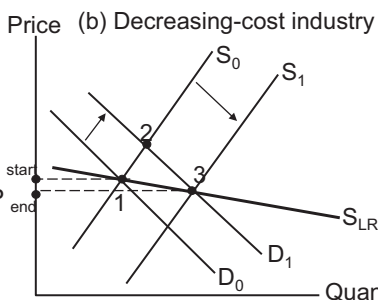
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Long-Run Industry Supply Curves

2014.06 (1)

- Increasing-cost industry:
- ✓ 行业产量↑成本↑
 - ✓ 产品价格与供给量成同方向变动
- Decreasing-cost industry:
- ✓ 行业产量↑成本↓
 - ✓ 产品价格与供给量成反方向变动
- Constant-cost industry:
- ✓ 行业产量↑成本→
 - ✓ 以不变的均衡价格提供产量



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Market Structure

2015.12 (1) 2015.06 (1)
2014.12 (1) 2014.06 (1)

| Type | Number of firms | Degree of difference of products | Degree of price control | Difficulty to enter or leave | The example in our life |
|--------------------------|-----------------------------|------------------------------------|-----------------------------|------------------------------|----------------------------|
| Perfect competition | many | No difference | No price control | Very easy | Some agricultural products |
| Monopolistic competition | many | Some difference | Some tiny price control | Relatively easy | Some retail products |
| Oligopoly | More than one, but not many | Little or no difference | Some control to some extent | difficult | Steel, automobile, oil |
| Pure monopoly | single | Sole product, nearly no substitute | perfectly control | No way | Public sectors |

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Monopolistic Competition

Monopolistic Competition

- Firms in monopolistic competition face downward-sloping demand curves and the curves are highly elastic because competing products are perceived by consumers as close substitutes

➤ Product development and marketing

- Innovation and product development
- Advertising
- Brand names

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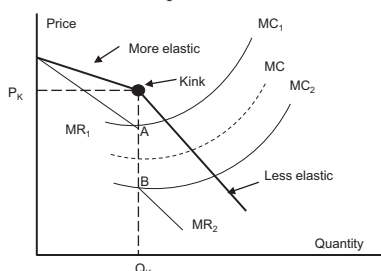
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Oligopoly: Kinked Demand Curve Model

- The **kinked demand curve model of oligopoly** is based on the assumption that each firm believes that if it raises its price, others will not follow, but if it cuts its price, other firms will cut theirs.

- Between range A and B, the optimum Q is constant, can't determine price
- Q_k is the profit-maximizing level of output and the price at which the kink is located is the firm's profit maximizing price.
- Shortcoming: it is incomplete because what determines the market price (where the kink is located) is outside the scope of the model.



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Nash Equilibrium Model (Prisoner's Dilemma)

- **Nash equilibrium** is reached when the choices of all firms are such that there is no other choice that makes any firm better off (increases profits or decrease loss)
- **Prisoners' Dilemma** is a game that illustrates that the best course of action for an oligopoly firm, when engaging in collusion with another oligopoly firm, is to cheat.

| | Prisoner B is silent | Prisoner B confesses |
|----------------------|------------------------------------|----------------------------------|
| Prisoner A is silent | A gets 6 months B gets 6 months | A gets 10 years B goes free |
| Prisoner A confesses | A goes free B gets 10 years | A gets 2 years B gets 2 years |

- Best overall outcome is for both to remain silent and get sentences of six months. But it is not equilibrium.
- **The Nash equilibrium is for both prisoners to confess**, and for each to get a sentence of two years.
- Confess/confess is the Nash equilibrium since neither prisoner can unilaterally reduce his sentence by changing to silence.

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Dominant Firm Model

- **Dominant firm model**
 - a single firm has a significantly large market share
 - ✓ greater scale
 - ✓ lower cost structure
 - market price is essentially determined by the dominant firm
 - the other competitive firms take this market price as given.

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Monopoly

- A monopolist faces a **downward sloping demand curve**. Just as price searchers with low entry barriers will expand output until marginal revenue equals marginal cost, so do monopolists. This will maximize profit. Positive economic profits can exist in the long run due to the high entry barriers.
- The monopolists want to **maximize profits, not price**, So they will not charge the highest possible price.
- The relationship between MR and price elasticity, Ep, is: $MR = P[1 - 1/E_p]$

2015.12 (1) 2015.06 (1)

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Price Discrimination

- **Price discrimination** is the practice of charging different consumers different prices for the same product or service.
 - **first-degree price discrimination**, where a monopolist is able to charge each customer the highest price the customer is willing to pay.
 - ✓ In practice, the monopolist is able to measure how often the product is used and charges the customer the highest price the consumer is willing to pay for that unit of good.
 - ✓ Another possibility is that public price disclosure is non-existent, so that no customer knows what the other customers are paying.
 - ✓ not every consumer is worse off in this case, because some consumers may be charged a price that is below that of perfect competition, as long as the marginal revenue exceeds the marginal cost.
 - **In second-degree price discrimination**, the monopolist uses the quantity purchased to establish whether the consumer values the product highly (and therefore is willing to pay a higher per unit price to purchase a large amount of it) or not very highly (and therefore is willing to pay only a low price and buy only a small amount).
 - ✓ the producer would sell small quantities at the marginal price but large quantities at a higher per unit price.
 - **Third-degree price discrimination** happens when customers are segregated by demographic or other traits.
- **Price discrimination reduces this inefficiency** by increasing output toward the quantity where marginal benefit equals marginal cost, and the deadweight loss is smaller.

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Government Regulation

- Regulators often attempt to increase competition and efficiency through efforts to reduce artificial barriers to trade, such as licensing requirement, quotas, and tariffs.
- **Government regulation**
 - **Average cost pricing** is the **more common form of regulation** at the point where $ATC=D$. This will:
 - ✓ Increase output and decrease price.
 - ✓ Increase social welfare (allocative efficiency).
 - ✓ Ensure the monopolist a normal profit (but no economic profit) since $price=ATC$.
 - **Marginal cost pricing** which is also referred to as efficient regulation, forces the monopolist to reduce price to the point where $MC=D$. this will:
 - ✓ Increase output and reduce price.
 - ✓ Causes the monopolist to incur a loss since price is below ATC .
 - ✓ Such a solution requires a government subsidy in order to provide the firm with a normal profit.
 - Another way of “regulating” a monopoly is for the government to sell the monopoly right to the highest bidder.

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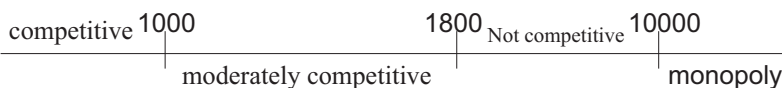
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Concentration Measures

2015.12 (1) 2015.06 (1)
2014.12 (1)

- **Concentration measures**
 - **The N-Firm Concentration Ratio**: the sum or the percentage market shares of the largest N firms in a market.
 - ✓ advantage: simple to compute
 - ✓ disadvantage: does not directly quantify market power
 - ✓ limitation: it may be relatively insensitive to mergers of two firms with large market shares.
 - **The Herfindahl-Hirschman Index (HHI)**: the sum of the squares of the market shares of the largest firms in the market.
 - ✓ limitation: both of our simple concentration measures is that barriers to entry are not considered in either case. Even a firm with high market share may not have much pricing power if barriers to entry are low and there is potential competition.



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GDP & GDP Deflator

➤ Gross domestic product (GDP) is the **total market value** of the **final goods and services produced in a country** within **a certain time period**.

➤ **GNP (Gross National Product)** measures the market value of all final goods and services produced by factors of production supplied by residents of a country, regardless of whether such production takes place within the country or outside of the country. 2014.12 (1)

➤ Implicit price deflator for GDP (GDP deflator) is a price index that can be used to convert nominal GDP into real GDP, taking out the effects of changes in the overall price level.

$$\begin{aligned} \text{GDP deflator for year } t &= \frac{\sum_{i=1}^N P_{i,t} Q_{i,t}}{\sum_{i=1}^N P_{i,t-5} Q_{i,t}} \times 100 && 2015.12 (1) \quad 2014.12 (1) \\ &= \frac{\text{nominal GDP in year } t}{\text{value of year } t \text{ output at year } t-5 \text{ prices}} \times 100 \end{aligned}$$

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GDP Calculation

➤ Under the **income approach**, we have the following equation for GDP:

GDP = national income + capital consumption allowance
+ statistical discrepancy

- A capital consumption allowance (CCA) measures the **depreciation** (i.e., wear) of physical capital from the production of goods and services over a period. CCA can be thought of as the amount that would have to be reinvested to maintain the productivity of physical capital from one period to the next.
- The statistical discrepancy is an adjustment for the difference between GDP measured under the income approach and the expenditure approach because they use different data.

2015.06 (1)

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National Income, Personal Income, and Personal Disposable Income

- **National income** is the sum of the income received by all factors of production that go into the creation of final output.
- national income = compensation of employees (wages and benefits) 工人
+ corporate and government enterprise profits before taxes 企业, 税前
+ interest income 资本
+ unincorporated business net income (business owners' incomes) 企业家
+ rent 租金
+ indirect business taxes less subsidies* 间接税
- *indirect taxes and subsidies that are included in final prices, 产品中的税主要包括sales taxes, fuel taxes, and import duties; 要素生产中的税主要包括property taxes and payroll taxes.
- **Personal income** = national income - indirect business tax - corporate income tax - undistributed corporate profit + Transfer payment
- **Personal disposable income** = personal income - personal taxes 2015.12 (1)

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GDP Calculation

2014.12 (1) 2014.06 (1)

- Using the **expenditure approach**, the major components of real GDP are consumption, investment, government spending, and net exports (exports minus imports). These components are summarized in the equation:
- $$GDP = C + I + G + (X - M)$$
- **Each of the components of GDP:**
- **Consumption** is a function of disposable income. An increase in personal income or a decrease in taxes will increase both consumption and saving. Additional disposable income will be consumed or saved. The proportion of additional income spent on consumption is called the **marginal propensity to consume (MPC)**, and the proportion saved is the **marginal propensity to save (MPS)**. $MPC + MPS = 1$
 - **Investment** is a function of expected profitability and the **cost of financing**. Expected profitability depends on the overall level of economic output. Financing costs are reflected in real interest rates, which are approximated by nominal interest rates minus the expected inflation rate.
 - **Government purchases** may be viewed as independent of economic activity to a degree, but tax revenue to the government, and therefore the fiscal balance, is clearly a function of economic output.
 - **Net exports** are a function of domestic disposable incomes (which affect imports), foreign disposable incomes (which affect exports), and relative prices of goods in foreign and domestic markets.

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IS Curves

- **The IS Curve**
- $Y = C + I + G + (X - M)$
- C和Y有关, I和i (利率) 有关, 其他都看成常数, 以上方程可以写成i和Y的函数, 这就是IS曲线;
 - IS曲线的shift:
 - ✓ G
 - ✓ $X - M$

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Money Demand

- **The Demand for money** is largely determined by interest rates and it is also influenced by income level and price level
- Three reasons for holding money:
 - **Transaction demand**: Money held to meet the need for undertaking transactions. As the level of real GDP increases, the size and number of transactions will increase, and the demand for money to carry out transactions increases
 - **Precautionary demand**: Money held for unforeseen future needs. In the aggregate, the total amount of precautionary demand for money increases with the size of the economy
 - **Speculative demand**: Money that is available to take advantage of investment opportunities that arise in the future. It is inversely related to returns available in the market.

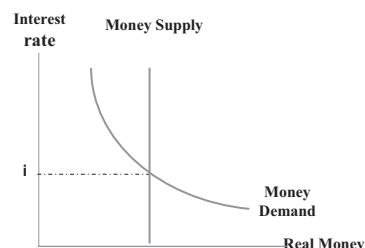
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Money Supply

- The **supply of money** is determined by the central bank and is not affected by changes in interest rates. Thus the supply of money curve is vertical
- **At lower interest rates, firms and households choose to hold more money. At higher interest rates, the opportunity cost of holding money increases, and firms and households will desire to hold less money and more interest-bearing financial assets.**



- Notice that as the Fed increases the money supply, the interest rate falls, which reduces the opportunity cost of holding money.

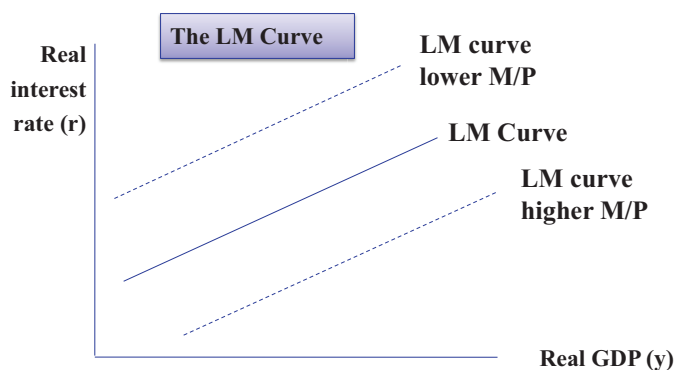
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LM Curves

- **The LM Curve**



In equilibrium, there is a *positive relationship between real income and the real interest rate* for a given level of the real money supply.

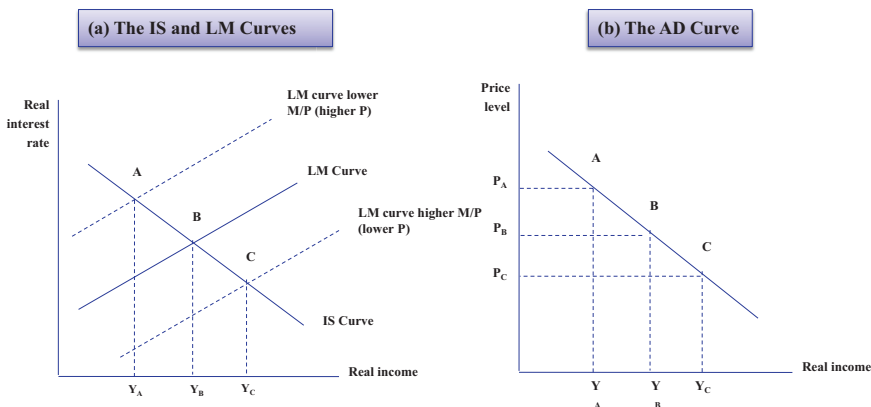
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Aggregate Demand Curve

➤ Deriving the Aggregate Demand Curve



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Shifts in the Aggregate Demand Curve

2015.06 (1)

2014.12 (1)

| Impact of Factors Shifting Aggregate Demand | | |
|---|---------------------------|--|
| An Increase in the Following Factors | Shifts the AD Curve | Reason |
| Stock prices | Rightward: Increase in AD | Higher consumption |
| Housing prices | Rightward: Increase in AD | Higher consumption |
| Consumer confidence | Rightward: Increase in AD | Higher consumption |
| Business confidence | Rightward: Increase in AD | Higher investment |
| Capacity utilization | Rightward: Increase in AD | Higher investment |
| Government spending | Rightward: Increase in AD | Government spending a component of AD |
| Taxes | Leftward: Decrease in AD | Lower consumption and investment |
| Bank reserves | Rightward: Increase in AD | Lower interest rate, higher investment and possibly higher consumption |
| Exchange rate (foreign currency per unit domestic currency) | Leftward: Decrease in AD | Lower exports and higher imports |
| Global growth | Rightward: Increase in AD | Higher exports |

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Aggregate Supply Curve

➤ Aggregate Supply Curve

- The **aggregate supply** (AS) curve describes the relationship between the price level and the quantity of real GDP supplied, when all other factors are kept constant. That is, it represents the amount of output that firms will produce at different price levels.
- We need to consider three aggregate supply curves with different time frames: the very short-run aggregate supply (VSRAS) curve, the short-run aggregate supply (SRAS) curve, and the long-run aggregate supply (LRAS) curve.
 - ✓ The VSRAS curve is perfectly elastic.
 - ✓ The LRAS curve is perfectly inelastic. In the long run, wages and other input prices change proportionally to the price level, so the price level has no long-run effect on aggregate supply. We refer to this level of output as potential GDP or full-employment GDP. 2015.12 (1) 2014.06 (1)
 - ✓ The SRAS curve is upward sloping.

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Shifts in the Aggregate Supply Curve

2015.06 (1) 2014.12 (1)

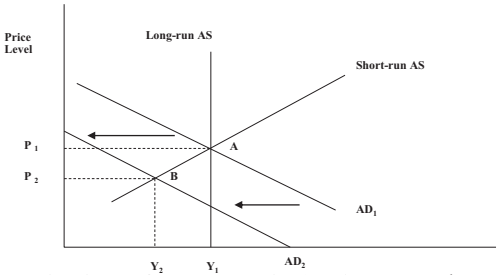
| Impact of Factors Shifting Aggregate Supply | | | |
|---|-------------|-------------|--|
| An Increase in | Shifts SRAS | Shifts LRAS | Reason |
| Supply of labor | Rightward | Rightward | Increases resource base |
| Supply of natural resources | Rightward | Rightward | Increases resource base |
| Supply of human capital | Rightward | Rightward | Increases resource base |
| Supply of physical capital | Rightward | Rightward | Increases resource base |
| Productivity and technology | Rightward | Rightward | Improves efficiency of inputs |
| Nominal wages | Leftward | No impact | Increases labor cost |
| Input prices (e.g., energy) | Leftward | No impact | Increases cost of production |
| Expectation of future prices | Rightward | No impact | Anticipation of higher costs and/or perception of improved pricing power |
| Business taxes | Leftward | No impact | Increases cost of production |
| Subsidy | Rightward | No impact | Lowers cost of production |
| Exchange rate | Rightward | No impact | Lowers cost of production |

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Recessionary Gap



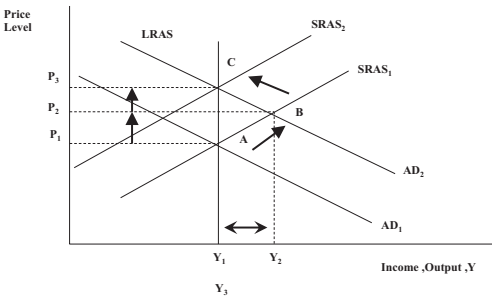
- **Investment Implications of a Decrease in AD** Aggregate demand and aggregate supply are theoretical measures that are very hard to measure directly. Most governments, however, publish statistics that provide an indication of the direction that aggregate demand and supply are moving over time.
- For example, statistics on consumer sentiment, factory orders for durable and nondurable goods, the value of unfilled orders, the number of new housing starts, the number of hours worked, and changes in inventories provide an indication of the direction of aggregate demand. If these statistics suggest that a recession is caused by a decline in AD, the following conditions are likely to occur:
 - Corporate profits will decline.
 - Commodity prices will decline.
 - Interest rates will decline.
 - Demand for credit will decline.

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Inflationary Gap



- **Investment Implications of an Increase in AD** resulting in an inflationary gap If economic statistics (consumer sentiment, factory orders for durable and nondurable goods, etc.) suggest that there is an expansion caused by an increase in AD, the following conditions are likely to occur:
 - Corporate profits will rise.
 - Commodity prices will increase.
 - Interest rates will rise.
 - Inflationary pressures will build.

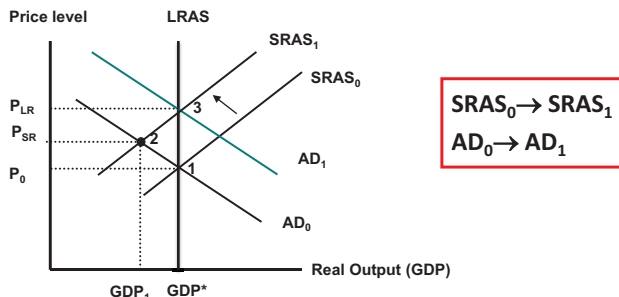
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Stagflation

- **Stagflation** refers to an environment of both high unemployment and increasing inflation. Stagflation is generally associated with a sharp decrease in aggregate supply.
- Stagflation is difficult for government policymakers to address because policy changes to reduce inflation tend to make unemployment worse, while policy changes to fight recession tend to make inflation worse.
 - If the government does not intervene, declines in wages and other input prices should return SRAS and real GDP to long-run equilibrium. However, this may be a slow process that makes it politically risky for the government to take no immediate action.



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Sources of Economic Growth

- Economic growth can best be explained by examining five important sources of economic growth:
- Labor supply**
 - Human capital**
 - Physical capital stock**
 - Technology**
 - Natural resources**

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Production Function

- A **production function** describes the relationship between output and labor, the capital stock, and productivity.
- Economic output can be thought of as a function of the amounts of labor and capital that are available and their productivity, which depends on the level of technology available. That is:

$$Y = A \times f(L, K)$$

where:

Y = aggregate economic output ;

L = size of labor force;

K = amount of capital available ;

A = total factor productivity

- Total factor productivity** is a multiplier that quantifies the amount of output growth that cannot be explained by the increases in labor and capital.

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Growth and Growth of Total Factor Productivity

- A well-known model of the contributions of technology, labor, and capital to economic growth is:
- growth in potential GDP =**
- growth in technology + W_L (growth in labor) + W_C (growth in capital)**
- where W_L and W_C are labor's percentage share of national income and capital's percentage share of national income.
- Growth in total factor productivity is driven by improvements in technology. Sometimes, the relationship between potential GDP, technology improvements, and capital growth is written on a per-capita basis as:
- growth in per-capita potential GDP =**
- growth in technology + W_C (growth in the capital-to-labor ratio)**

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Characteristics of Different Business Cycle Phase

2015.12 (1)
2015.06 (1)
2014.06 (1)

| | Early Expansion (Recovery) | Late Expansion | Peak | Contraction (Recession) |
|--------------------------------|--|--|---|---|
| Economic Activity | ►Gross domestic (GDP), Industrial production, and other measures of economic activity turn from decline to expansion. | ►Activity measures show an accelerating rate of growth. | ►Activity measures show decelerating rate of growth. | ►Activity measures show outright declines. |
| Employment | ►Layoff slow (and net Employment turns positive), but new hiring does not yet occur and the unemployment rate remains high. At first, business turns to overtime and temporary employees to meet rising product demands. | ►Business begins full time Rehiring as Overtime hours rise. The unemployment rate falls to low levels. | ►Business slows its rate of hiring; however, the unemployment rate continues to Fall | ►Business first cuts hours and freezes hiring, followed by outright layoffs. The unemployment rate rises. |
| Consumer and Business Spending | ►Upturn often most Pronounced in housing, durable consumer items, and orders for light producer equipment. | ►Upturn becomes more broad-based. Business begins to order heavy equipment and engage in construction. | ►Capital spending expands rapidly, but the growth rate of spending starts to slow down. | ►Cutbacks appears most in industrial production, housing, consumer durable items and orders for new business equipment, followed, with a lag, by cutbacks in other forms of capital spending. |
| Inflation | ►Inflation remains moderate and may continue to fall | ►Inflation picks up modestly. | ►Inflation further accelerates | ►Inflation decelerates but with a lag. |

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Theories of the Business Cycle

2015.12 (1) 2015.06 (1)
2014.12 (1)

➤ Neoclassical school

- Believe shifts in both aggregate demand and aggregate supply are primarily driven by changes in technology over time.
- 技术的改变引起经济周期，主张政府不要干预经济

➤ Keynesian school

- Believe that shifts in aggregate demand due to changes in expectations were the primary cause of business cycles.
 - Argue that wages are “downward sticky”, reducing the ability of a decrease in money wages to increase short-run aggregate supply and move the economy from recession (or depression) back toward full employment.
 - The policy prescription of Keynesian economists is to directly increase aggregate demand through monetary policy or through fiscal policy.
- 总需求的改变导致了企业家预期的改变，从而引起了经济周期
主张：政府直接干预经济

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Theories of the Business Cycle

➤ Monetarist school

- The quantity theory of money: $MV=PY$ 2014.06 (1)
- Believe the variations in aggregate demand that cause business cycles are due to variations in the rate of growth of the money supply, likely from inappropriate decisions by the monetary authorities.
- Suggest that to keep aggregate demand stable and growing, the central bank should follow a policy of steady and predictable increases in the money supply.

由于央行无规律的货币供给导致了经济周期，主张央行不要乱发货币

➤ Austrian school

政府参与引起经济周期，主张政府不要干预经济

➤ New Classical school introduced real business cycle theory (RBC).

实际经济变量（外部冲击&技术）影响了经济周期，主张政府不要干预

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Key Terms in the Labor Market

2015.06 (2) 2014.06 (1)

➤ Employed: number of people with a job.

- This figure normally does not include people working in the informal sector (e.g., unlicensed cab drivers, illegal workers, etc.)

➤ Labor force: number of people who either have a job or are actively looking for a job.

- This number excludes retirees, children, stay-at-home parents, fulltime students, and other categories of people who are neither employed nor actively seeking employment.

➤ Participation ratio (also referred to as the activity ratio or labor force participation rate) is the percentage of the working-age population who are either employed or actively seeking employment

$$\text{labor force participation rate} = \frac{\text{labor force}}{\text{Working - age population}} \times 100$$

➤ Unemployment rate is the percentage of people in the labor force who are unemployed.

$$\text{unemployment rate} = \frac{\text{number of unemployed}}{\text{labor force}} \times 100$$

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Inflation, Deflation and Disinflation

2015.06 (1)

- **Inflation** is a persistent increase in the price level over time.
 - If inflation is present, the prices of almost all goods and services are increasing.
 - **Inflation rate** is the percentage increase in the price level, typically compared to the prior year.
 - **Hyperinflation**: an extremely fast increase in aggregate price level, which corresponds to an extremely high inflation rate.
- **Deflation**: a sustained decrease in aggregate price level, which corresponds to a negative inflation rate.
- **Disinflation**: a decline in the inflation rate.
 - Disinflation is very different from deflation because even after a period of disinflation, the inflation rate remains positive and the aggregate price level keeps rising (although at a slower speed).

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Inflation Measurements

- **CPI** is the best known indicator of U.S. inflation. The CPI measures the average price for a defined “basket” of goods and services that represents the purchasing patterns of a typical urban household.
- **Price index for personal consumption expenditures**
- **GDP deflator**
- **Producer price index (PPI): reflect future PPI**
 - Reflect the price changes experienced by domestic producers in a country.
 - Include: fuels, farm products (such as grains and meat), machinery and equipment, chemical products (such as drugs and paints), transportation equipment, metals, pulp and paper, and so on.
- **Wholesale price index (WPI)**
 - In some countries, the PPI is called the WPI.
- For both consumer and producer prices, analysts and policymaker often distinguish between headline inflation and core inflation.
 - **Headline inflation** refers to price indexes for all goods.
 - **Core inflation** refers to price indexes that exclude food and energy. Thus, core inflation can sometimes be a more useful measure of the underlying trend in prices.

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Inflation Measurement - CPI

2015.06 (1)

| Item | Quantity in base period | Price in base period | Quantity in current period | Current price |
|-----------------------|-------------------------|----------------------|----------------------------|---------------|
| Cheeseburgers | 200 | 2.50 | 205 | 3.00 |
| Movie tickets | 50 | 7.00 | 45 | 10.00 |
| Gasoline (in gallons) | 300 | 1.50 | 295 | 3.00 |
| Digital watches | 100 | 12.00 | 105 | 9.00 |

Reference base period:

| | | |
|----------------|---------------|-----------------|
| Cheeseburgers | 205 × 2.50 = | 512.50 |
| Movie tickets | 45 × 7.00 = | 315.00 |
| Gasoline | 295 × 1.50 = | 442.50 |
| Watches | 105 × 12.00 = | <u>1,260.00</u> |
| Cost of basket | | 2,530.00 |

Current period:

| | | |
|----------------|--------------|---------------|
| Cheeseburgers | 205 × 3.00 = | 615.00 |
| Movie tickets | 45 × 10.00 = | 450.00 |
| Gasoline | 295 × 3.00 = | 885.00 |
| Watches | 105 × 9.00 = | <u>945.00</u> |
| Cost of basket | | 2,895.00 |

$$\text{Paasche index} = \frac{2,895}{2,530} \times 100 = 114.43$$

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Laspeyres Index

- **Laspeyres index:** uses a constant basket of goods and services. Most countries calculate consumer price inflation this way.
- Three factors cause a Laspeyres index of consumer prices to be biased upward as a measure of the cost of living:
 - **New goods.** Older products are often replaced by newer, but initially more expensive, products. New goods are periodically added to the market basket, and the older goods they replace are reduced in weight in the index. This biases the index upward.
 - **Quality changes.** If the price of a product increases because the product has improved, the price increase is not due to inflation but still increases the price index.
 - **Substitution.** Even in an inflation-free economy, prices of goods relative to each other change all the time. When two goods are substitutes for each other, consumers increase their purchases of the relatively cheaper good and buy less of the relatively more expensive good. Over time, such changes can make a Laspeyres index's fixed basket of goods a less accurate measure of typical household spending.

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Hedonic Pricing, Fisher Index, and Paasche Index

- Solution for Laspeyres index biases:
 - Many countries adjust for the quality of the products in a basket, a practice called hedonic pricing.
 - New products can be introduced into the basket over time.
 - The substitution bias can be somewhat resolved by using chained price index formula.
 - ✓ One such example is the Fisher index, which is the geometric mean of the Laspeyres index and the Paasche index.
 - Paasche index is an index formula using the current composition of the basket.

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Inflation

- An inflation that results from an initial increase in costs is called **cost-push inflation**. The two main sources of increases in costs are
 - An increase in money wage rates
 - An increase in the money prices of raw materials
- **Demand-pull inflation:** an inflation that results from an initial increase in aggregate demand
 - Factors:
 - ✓ Increase in the quantity of money
 - ✓ Increase in government purchases
 - ✓ Increase in exports

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Economic Indicators

2015.12 (1)

| Leading | Reason |
|---|--|
| Average weekly hours, manufacturing | Because businesses will <u>cut overtime before laying off workers in a downturn</u> and increase it before rehiring in a cyclical upturn, these measures move up and down <u>before the general economy</u> . |
| Average weekly initial claims for unemployment insurance | This measure offers a very <u>sensitive test of initial layoffs and rehiring</u> . |
| Interest rate spread between 10-year treasury yields and overnight borrowing rates (federal funds rate) | Because <u>long-term yields express market expectations about the direction of short-term interest rates</u> , and rates ultimately follow the economic cycle up and down, a wider spread, by <u>anticipating short rate increases, also anticipates an economic upswing</u> . Conversely, a narrower spread, by anticipating short rate decreases, also anticipates an economic downturn. |
| Lagging | Reason |
| Inventory—sales ratio | Because <u>inventories accumulate as sales initially decline and then</u> , once a business adjusts its ordering, become <u>depleted as sales pick up</u> , this ratio tends to lag the cycle. |

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How Money is Created

2015.12 (1) 2014.06 (1)

How Do the Banks Create Money ?

| | reserve | loan |
|-------|---------|------|
| Bank1 | | 100 |
| Bank2 | 10 | 90 |
| Bank3 | 9 | 81 |
| ... | ... | ... |

$Ms=100/(1-0.9)=1000$

money created = $\frac{\text{new deposit}}{\text{reserve requirement}} = \frac{100}{0.1} = 1000$

money multiplier = $\frac{1}{\text{reserve requirement}} = \frac{1}{0.1} = 10$

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Fisher Effect

2015.12 (2) 2014.12 (2)
2014.06 (1)

- The **Fisher effect** states that the nominal interest rate is simply the sum of the real interest rate and expected inflation.
- $R_{\text{Nom}} = R_{\text{Real}} + E[I]$
 R_{Nom} = nominal interest rate
 R_{Real} = real interest rate
 $E[I]$ = expected inflation
 - The idea behind the Fisher effect is that real rates are relatively stable, and changes in interest rates are driven by changes in expected inflation. This is consistent with money neutrality.

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Tools of the Central Bank

- **Policy rate**
- In the United States, banks can borrow funds from the Fed. The rate at which banks can borrow reserves from the Fed is termed the discount rate. For the European Central Bank (ECB), it is called the refinancing rate.
 - One way to lend money to banks is through a repurchase agreement. The Bank of England uses this method, and policy rate is called the two-week repo (repurchase) rate.
 - In the United States, the federal funds rate is the rate that banks charge each other on overnight loans of reserves.
 - A lower rate reduces banks' cost of funds encourage lending, and tends to decrease interest rates.
 - A higher policy rate increases banks' cost of funds discourage lending, and tends to increase interest rates.

美联储：联邦基金利率，商行和商行之间的隔夜拆借利率

欧洲：再贴现率，商行跟央行融资的利率

Policy rate ↓ → 融资成本低，释放流动性（扩张的货币政策）

Policy rate ↑ → 融资成本高，收紧流动性（紧缩的货币政策）

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Tools of the Central Bank

- **Reserve requirements**
- Reserve requirement ↑ - available funds for lending ↓ - money supply ↓ - interest rate ↑
 - This tool only works well to increase the money supply if banks are willing to lend and customers are willing to borrow.
存款准备金 ↑ → 紧缩的货币政策
存款准备金 ↓ → 扩张的货币政策
- **Open market operations** 2014.12 (1)
- Central bank buy securities – funds available funds for lending ↑ - money supply ↑ - interest rate ↓
 - This tool is the Fed's most commonly used tool and is important in achieving the federal funds target rate (policy rate).
央行买债券 → 扩张的货币政策
央行卖债券 → 紧缩的货币政策

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Neutral interest rate

2015.12 (1) 2014.06 (1)

- An economy's long-term sustainable real growth rate is called the **real trend rate** or, the **trend rate**.
- The **neutral interest rate** of an economy is the growth rate of the money supply that neither increases nor decreases the economic growth rate:
$$\text{Neutral interest rate} = \text{real trend rate of economic growth} + \text{inflation target}$$
 - Policy rate > Neutral rate: contractionary
 - Policy rate < Neutral rate: expansionary

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Limitation of Monetary Policy

- The transmission mechanism for monetary policy does not always produce the intended results.
 - Long-term rates may not rise and fall with short-term rates because of the effect of monetary policy changes on expected inflation.
- Another situation in which the transmission mechanism may not perform as expected is if demand for money becomes very elastic and individuals willingly hold more money even without a decrease in short-term rates. Such a situation is called a **liquidity trap**. 2014.06 (1)

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Fiscal Policy Tools

2014.06 (1)

- **Spending Tools**
 - **Transfer payments**: Redistribute wealth, taxing some and making payments to others, transfer payments are not included in GDP computations. (e.g: social security and unemployment insurance benefits)
 - **Current spending**: refers to government purchases of goods and services on an ongoing and routine basis.
 - **Capital spending**: refers to government spending on infrastructure such as roads, schools, bridges, and hospitals. Capital spending is expected to boost future productivity of the economy
- **Revenue Tools**
 - **Direct taxes** are levied on income or wealth. These include income taxes, taxes on income for national insurance, wealth taxes, estate taxes, corporate taxes, capital gains taxes, and Social Security taxes. Some progressive taxes (such as income and wealth taxes) generate revenue for wealth and income redistributing.
 - **Indirect taxes** are levied on goods and services. These include sales taxes, value-added taxes (VATs), and excise taxes. Indirect taxes can be used to reduce consumption of some goods and services (e.g., alcohol, tobacco, gambling). 影响更快

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Limitations of Fiscal Policy

➤ **Limitations** of Discretionary Fiscal Policy:

- The lag can be divided into three types:
 - ✓ **Recognition lag**: Discretionary fiscal policy decisions are made by a political process. The state of the economy is complex, and it may take policymakers time to recognize the nature and extent of the economic problems.
 - ✓ **Law-making lag**: The time governments take to discuss, vote on, and enact fiscal policy changes.
 - ✓ **Impact lag**: The time between the enactment of fiscal policy changes and when the impact of the changes on the economy actually takes place. It takes time for corporations and individuals to act on the fiscal policy changes, and fiscal multiplier effects occur only over time as well.
- **Crowding-out effect**: Expansionary fiscal policy may crowd out private investment, reducing the impact on aggregate demand. 2015.06 (1)

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Limitations of Fiscal Policy - Ricardian Equivalence

- **Ricardian Equivalence**: Increases in the current deficit mean greater taxes in the future.
 - To maintain their preferred pattern of consumption over time, taxpayers may increase current savings (reduce current consumption) in order to offset the expected cost of higher future taxes.
 - If taxpayers reduce current consumption and increase current saving by just enough to repay the principal and interest on the debt the government issued to fund the increased deficit, there is no effect on aggregate demand.
- **If taxpayers underestimate their future liability** for servicing and repaying the debt, so that aggregate demand is increased by equal spending and tax increases, Ricardian equivalence does not hold.

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Fiscal Multiplier

➤ **Fiscal multiplier**

- Fiscal multiplier = $\frac{1}{1 - MPC(1-t)} = \frac{1}{1 - b \times (1-t)}$
- MPC: Marginal propensity of consumption (b)
- The fiscal multiplier is inversely related to the tax rate (higher tax rate decreases the multiplier) and directly related to the marginal propensity to consume (higher MPC increases the multiplier).

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Absolute and Comparative Advantage

2015.12 (1) 2015.06 (1)
2014.12 (1) 2014.06 (1)

- If two countries have different opportunity cost of producing **The law of comparative advantage** holds that trading partners can be made better off if they specialize in the production of goods for which they are the low-opportunity cost producer and trade for those goods for which they are the high-opportunity cost producer.
- When each country specializes in the good for which they have a comparative advantage and trades each other, there are clear gains existed.

| Country Product | A | B |
|--------------------|----|---|
| X | 10 | 9 |
| Y | 5 | 3 |

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Ricardian Model and Heckscher-Ohlin Model

- In the Ricardian model, labor is the only (variable) factor of production. Differences in labor productivity, reflecting underlying differences in technology, are the source of comparative advantage and hence the key driver of trade in this model.
- In the Heckscher—Ohlin Model (also known as the factor-proportions theory), both capital and labor are variable factors of production.
 - Differences in the relative endowment of these factors are the source of a country's comparative advantage.
 - A country has a comparative advantage in goods whose production is intensive in the factor with which it is relatively abundantly endowed, and would tend to specialize in and export that good.
 - ✓ Capital is relatively more (less) abundant in a country if the ratio of its endowment of capital to labor is greater (less) than that of its trading partner.
 - ✓ For this country, labor is relatively abundant would export relatively labor-intensive goods and import relatively capital-intensive goods.
 - It allows for the possibility of income redistribution through trade.
 - ✓ The price of the relatively less scare (more available) factor of production in each country will increase.
 - ✓ The good that a country imports will fall in price (that is why they import it), and the good that a country exports will rise in price.

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Types of Trade Restrictions

➤ Types of trade restrictions include:

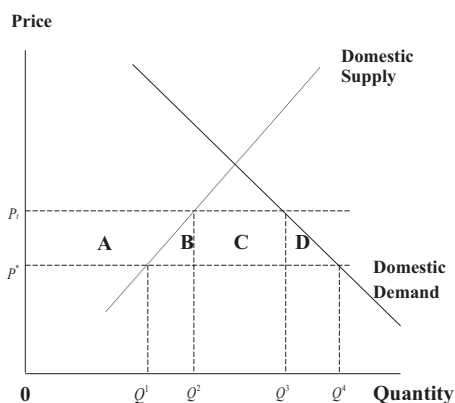
- **Tariffs**: taxes on imported good collected by the government.
- **Quotas**: limits on the amount of imports allowed over some period.
- **Export subsidies**: government payments to firms that exports goods.
- **Minimum domestic content**: requirement that some percentage of product content must be from the domestic country.
- **Voluntary export restraint**: a country voluntarily restricts the amount of a good that can be exported, often in the hope of avoiding tariffs or quotas imposed by their trading partner.

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Welfare Effects of an Import Tariff or Quota



| | Importing Country |
|-------------------------------|-------------------|
| Consumer surplus | -(A+B+C+D) |
| Producer surplus | +A |
| Tariff revenue or Quota rents | +C |
| National welfare | -B-D |

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BOP Components

2015.12 (1) 2015.06 (1)

➤ **Current account** measures the flows of goods and services.

- **Merchandise and services**
 - ✓ **Merchandise** consists of all raw materials and manufactured goods bought, sold, or given away.
 - ✓ **Services** include tourism, transportation, and business and engineering services, as well as fees from patents and copyrights on new technology, software, books, and movies.
- **Income receipts** include foreign income from dividend on stock holdings and interest on debt securities
- **Unilateral transfers** are one-way transfers of assets, such as money received from those working abroad and direct foreign aid.

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International organization

2015.06 (1)

- International organization
 - International Monetary Fund (IMF)
 - World Bank
 - World Trade Organization (WTO)

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Framework of Economics

- SS 4 Microeconomic Analysis
 - R13 demand and supply: introduction
 - R14 demand and supply: consumer demand introduction
 - R15 demand and supply: the firm
 - R16 the firm and the market structure
- SS 5 Macroeconomic Analysis
 - R17 aggregate output, price, and economic growth
 - R18 understand business cycles
 - R19 monetary and fiscal Policy
- SS 6 Economics in a Global Context
 - R20 international trade and capital flow
 - R21 currency exchange rate

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Nominal and Real Exchange Rate

- Exchange rate is simply the price or cost of units of one currency in terms of another.
- Nominal exchange rate: the price that we observe in the marketplace for foreign exchange.
- Real exchange rate: the focus shifts from the quotations in the foreign exchange market to what the currencies actually purchase in terms of real goods and services.
 - $FX\ real(d/f) = FX\ nominal\ (d/f) * CPI_f / CPI_d$
 - Changes in real exchange rates can be used *when analyzing economic changes over time*.
 - ✓ When the real exchange rate (d/f) increases, exports of goods and services have gotten relatively less expensive to foreigners, and imports of goods and services from the foreign country have gotten relatively more expensive over time
- **Example:** At a base period, the CPIs of the U.S. and U.K. are both 100, and the exchange rate is \$1.70 per euro. Three years later, the exchange rate is \$1.60 per euro, and the CPI has risen to 110 in the U.S. and 112 in the U.K.. What is the real exchange rate?
- **Solution:** The real exchange rate is $\$1.60\ per\ euro * 112 / 110 = \$1.629\ per\ euro$.

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Cross Rate

2015.12 (1)
2014.12 (1) 2014.06 (1)

- **Cross rate** is the exchange rate between two currencies implied by their exchange rates with a common third country.
- **Example:**
 - USD/AUD = 0.60, MXN/USD = 10.70
 - ✓ MXN/AUD = USD/AUD * MXN/USD = 0.60 * 10.70 = 6.42
 - CHF/USD = 1.7799, NZD/USD = 2.2529
 - ✓ CHF/NZD = (CHF/USD) / (NZD/USD) = 1.7799 / 2.2529 = 0.7900

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Forward Discount or Premium

- **Forward discount or premium**
 - With the convention of giving the value of the quoted currency (the first currency) in terms of units of the second currency, there is a premium on the quoted currency when the forward exchange rate is higher than the spot rate and a discount otherwise.
- **Example:**
 - The AUD/EUR spot exchange rate is 0.7313 with the 1-year forward rate quoted at +3.5 points.
 - ✓ What is the 1-year forward AUD/EUR exchange rate?
 - ✓ Is the euro trading at a forward discount or forward premium relative to the Australian dollar?
 - Solution:
 - ✓ The forward exchange rate is $0.7313 + 0.00035 = 0.73165$.
 - ✓ Because the price of euros in AUD is higher one year out, the euro is trading at a forward premium (and the AUD a forward discount).

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Interest Rate Parity (IRP)

2015.06 (1) 2014.12 (2)

- **Interest rate parity (IRP)** holds when any forward premium or discount just offsets differences in interest rates so that an investor will earn the same return investing in either currency. Approximated by equating the difference between the domestic interest rate and the foreign interest rate to the forward premium or discount.
- Interest rate parity relationship:
 - F (forward), S (spot) X/Y, r_X and r_Y is the nominal risk-free rate in X and Y
 - $\frac{F}{S} = \frac{1 + r_X}{1 + r_Y}$
 - $\frac{F - S}{S} = \frac{1 + r_X}{1 + r_Y} - 1 = \frac{r_X - r_Y}{1 + r_Y} \approx r_X - r_Y$
- The forward rate will be higher than (be at a premium to) the spot rate if the nominal risk-free rate in X is higher than that in Y.
- More generally, and regardless of the quoting convention, the currency with the higher (lower) interest rate will always trade at a discount (premium) the forward market.

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Exchange Rate Regimes

2014.12 (1) 2014.06 (1)

- Countries That Do Not Have Their Own Currency:
 - A country can use the currency of another country (**formal dollarization**) not create money/currency.
 - A country can be a member of a **monetary union** in which several countries use a common currency (eg:Euro)
- Countries That Have Their Own Currency:
 - A currency board arrangement is an explicit commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate (notable example of such an arrangement is Hong Kong, central bank is not the last resort)
 - conventional fixed peg arrangement a country pegs its currency within margins of ± 1 percent versus another currency or a basket that includes the currencies of its major trading or financial partners
 - ✓ direct intervention: The monetary authority can maintain exchange rates within the band by purchasing or selling foreign currencies in the foreign exchange market
 - ✓ indirect intervention: including changes in interest rate policy, regulation of foreign exchange transactions, and convincing people to constrain foreign exchange activity

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Exchange Rate Regimes

- Countries That Have Their Own Currency:
 - Target zone: the permitted fluctuations in currency value relative to another currency or basket of currencies are wider (e.g., $\pm 2\%$)
 - Crawling peg: the exchange rate is adjusted periodically, typically to adjust for higher inflation
 - ✓ passive crawling peg: a series of exchange rate adjustments over time is announced and implemented
 - ✓ active crawling peg: can influence inflation expectations, adding some predictability to domestic inflation
 - Management of exchange rates within crawling bands: the width of the bands that identify permissible exchange rates is increased over time
 - Managed floating exchange rates: the monetary authority attempts to influence the exchange rate in response to specific indicators such as the balance of payments, inflation rates, or employment without any specific target exchange rate or predetermined exchange rate path
 - Independently floating: the exchange rate is market-determined, and foreign exchange market intervention is used only to slow the rate of change and reduce short-term fluctuations, not to keep exchange rates at a certain target level

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Elasticity Approach

- Two approaches to exam how changes in exchange rates affect the balance of trade:
 - Elasticity approach
 - Absorption approach
- Elasticity approach

$$\omega_M = \frac{\text{Imports}}{\text{imports} + \text{exports}} \quad \omega_X = \frac{\text{exports}}{\text{imports} + \text{exports}}$$

ε_M : elasticities (as positive numbers) of demand for imports

ε_X : elasticities (as positive numbers) of demand for exports
- Given Marshall-Lerner condition: $\omega_X \varepsilon_X + \omega_M (\varepsilon_M - 1) > 0$
- When import expenditures=export revenues, $\omega_X = \omega_M \rightarrow \varepsilon_X + \varepsilon_M > 1$
 - $\varepsilon_X > - (W_M/W_X)(\varepsilon_M - 1)$
 - $\varepsilon_M > 1 - (W_X/W_M) \varepsilon_X$

106-109

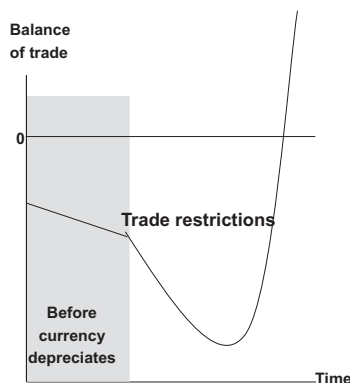
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J-Curve

➤ The J-Curve

- import and export contracts delivery and payment in the future, import and export quantities may be relatively insensitive to currency depreciation in the short run means currency depreciation may worsen a trade deficit in the short run.
- given the existence of such contracts and the resulting insensitivity of both import and export quantities to currency depreciation, import expenditures may rise in the short run as export prices rise, and export revenues may fall as export prices (in the domestic currency) fall, even when the Marshall-Lerner condition is met.
- This short-term increase in the deficit followed by a decrease when the Marshall-Lerner condition is met.



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Absorption Approach

➤ Absorption approach

- $BT = Y - E$
 - ✓ Y = domestic production of goods and services or national income
 - ✓ E = domestic absorption of goods and services, which is total expenditure
 - ✓ BT = balance of trade
- The economy is operating at less than full employment:
 - ✓ Depreciation \rightarrow price of domestic goods and assets $\downarrow \rightarrow$ expenditures and income $\uparrow \rightarrow$ saving $\uparrow \rightarrow$ trade balance improved
- The economy is operating at full employment:
 - ✓ Depreciation \rightarrow value of domestic assets $\downarrow \rightarrow$ savers' real wealth $\downarrow \rightarrow$ saving $\uparrow \rightarrow$ wealth $\uparrow \rightarrow$ positive impact on saving $\downarrow \rightarrow$ returning the economy to its previous state and balance of trade

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It's not the end but just the beginning.

Your life can be enhanced, and your happiness enriched, when you choose to change your perspective. Don't leave your future to chance, or wait for things to get better mysteriously on their own. You must go in the direction of your hopes and aspirations. Begin to build your confidence, and work through problems rather than avoid them. Remember that power is not necessarily control over situations, but the ability to deal with whatever comes your way.

一旦变换看问题的角度，你的生活会豁然开朗，幸福快乐会接踵而来。别交出掌握命运的主动权，也别指望局面会不可思议的好转。你必须与内心希望与热情步调一致。建立自信，敢于与困难短兵相接，而非绕道而行。记住，力量不是驾驭局势的法宝，无坚不摧的能力才是最重要的。

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CFA一级培训项目

Fixed Income



单晨玮

金程教育资深培训师

计算知识点

1. TIPS
2. Valuation with a single yield
3. The value change attributable to the passage of time
4. Arbitrage-free bond valuation
5. Accrued interest and full price
6. Matrix pricing
7. Floating rate notes valuation
8. Discount rate, add on yield, and BEY
9. Spot rate and forward rate
10. Reinvestment income & annualized HPR
11. Duration: Macaulay duration, Modified duration, Approximate modified duration, Effective duration
12. Money duration & PVBP
13. Portfolio duration
14. Convexity: Approximate convexity & Effective convexity
15. Price change based on duration and convexity

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Framework of Fixed Income

➤ Study Session 15 — Basic Concepts

● R52 Fixed-Income Securities: Defining Elements

- R53 Fixed-Income Markets: Issuance, Trading, and Funding
- R54 Introduction to Fixed-Income Valuation
- R55 Introduction to Asset-Backed Securities

➤ Study Session 16 — Analysis of Risk

- R56 Understanding Fixed-Income Risk and Return
- R57 Fundamentals of Credit Analysis

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Framework

- Basic features of a bond
- Bond indenture
 - Legal information
 - Collateral
 - Credit enhancements
 - Covenants
 - Tax
- Structure of a bond's cash flows
 - Principal repayment structures
 - Coupon payment structures
- Bonds with contingency provisions
 - Callable bonds
 - Puttable bonds
 - Convertible bonds

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Basic features of a bond

- Basic features of a bond
 - **Issuer/borrower:** 债券发行人，实际上为资金需求者
 - **Bondholder:** 债券持有人，实际上为资金的供给者
 - **Maturity date:** the date on which the principal is to be repaid
 - **Term to maturity(tenor):** the time remaining until maturity once a bond has been issued
 - **Par value//face value/ maturity value:** 面值，多数债券面值为1000
 - **Coupon rate:** 息票率，决定每期支付的利息

5-88

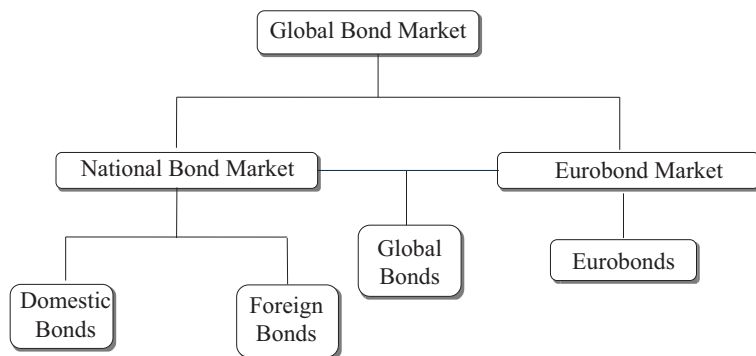
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Bond Market

2015.06 (1)

- Sectors of the bond market



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Basic Features of A Bond

- **Trust deed:** legal contract that describes the form of the bond, the obligations of the issuer, and the rights of the bondholders.
 - In the United states and Canada, it is called **bond indenture**.
 - The indenture is written in the name of the issuer and references the features of the bond issue
- Other legal and regulatory issue addressed in a trust deed include:
 - **Legal information** about the entities issuing the bond
 - Any assets(**collateral**) pledged to support repayment of the bond.
 - Any additional features that increase the probability of repayment (**credit enhancements**)
 - **Covenants**
 - **Tax**

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Legal and Regulatory Issues Addressed in a Trust Deed

- Legal information about issuing entities
 - Sovereign bonds: issued by the treasury of the issuing country.
 - Corporate bonds: issued by well-known corporation, by a subsidiary, or by a holding company.
 - **Securitized bonds:** issued by a separate legal entity created for the purpose of owning specific assets which is called special purpose entities(SPEs) in U.S, and special purpose vehicles(SPVs) in Europe.
 - ✓ SPVs is bankruptcy remote because the assets can provide cash flows to support the payment of the bond even if the company defaults.
 - ✓ The transfer of assets by the sponsor is considered a legal sale; once the assets have been securitized, the sponsor no longer has ownership rights.
 - ✓ Any party making claims following the bankruptcy of the sponsor would be unable to recover the assets or their proceeds.

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Legal and Regulatory Issues Addressed in a Trust Deed

- Source of repayment proceeds:

| Types of bond | Source of repayment |
|-----------------------------|--|
| Supranational organizations | <ul style="list-style-type: none">• repayment of previous loans• paid-in capital from its members |
| Sovereign bonds | <ul style="list-style-type: none">• Tax revenues• Print money |
| Non-sovereign debt | <ul style="list-style-type: none">• General taxing authority of issuer• Cash flows of the financed project (revenues)• Special taxes or fees |
| Corporate bonds | <ul style="list-style-type: none">• Cash flows from operations |
| Securitizations | <ul style="list-style-type: none">• Cash flows generated by one or more underlying financial assets. |

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Legal and Regulatory Issues Addressed in a Trust Deed

➤ **Asset or collateral backing:** a way to reduce credit risk.

- Unsecured bonds: represent a claim to the overall assets and cash flows of issuer.
- Secured bonds: backed by a claim to a specific assets of a corporation.
 - ✓ Assets pledged to support a bond issue are referred to collateral
- Unsecured bonds are paid after secured bonds in the event of default.
- In many jurisdictions, debentures are unsecured bonds, with no collateral backing assigned to the bondholders.

➤ Types of collateral backing:

| Types of bond | Collateral backing |
|----------------------------------|--|
| Collateral trust bonds | • Financial assets |
| Equipment trust certificates | • Specific types of equipment or physical assets (e.g. railroad cards, oil drilling) |
| Mortgage-backed securities (MBS) | • Mortgage loans |
| Covered bond | • A segregated pool of assets called a “covered pool” |

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Legal and Regulatory Issues Addressed in a Trust Deed

➤ **Credit enhancement:** a variety of provisions used to reduce the credit risk of a bond issue.

● **Internal credit enhancement:**

- ✓ **Overcollateralization:** the collateral pledged has a value greater than the par value of the debt issued
- ✓ **Excess spread:** the yield on the financial assets supporting the debt is greater than the yield promised on the bonds issued.
- ✓ Divide a bond into **tranches** with different seniority of claims: any losses of assets supporting a securitized bond are first absorbed by the bonds with the lowest seniority, then the bonds with the next-lowest priority of claims. — waterfall structure

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Legal and Regulatory Issues Addressed in a Trust Deed

● **External credit enhancement:**

- ✓ Surety bond: issued by insurance companies and are a promise to make up any shortfall in the cash available to service the debt.
- ✓ Bank guarantee: similar to surety bond, the major difference is that it issued by a bank.
- ✓ Letter of credit: a promise to lend money to the issuing entity if it does not have enough cash to make the promised payments on the covered debt.

➤ **Limitation of External credit enhancement:**

- while external credit enhancements increase the credit quality of debt issues and decrease the yields, deterioration of credit quality of the guarantor will also reduce the credit quality of the covered issue.
- Surety bonds, bank guarantees, and letters of credit expose the investor to third-party (or counterparty) risk, the possibility that a guarantor cannot meet its obligations.

➤ A **cash collateral account** mitigates this concern because the issuer immediately borrows the credit-enhancement amount and then invests that amount, usually in highly rated short-term commercial paper. Because this is an actual deposit of cash rather than a pledge of cash, a downgrade of the cash collateral account provider will not necessarily result in a downgrade of the bond issue backed by that provider.

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Legal and Regulatory Issues Addressed in a Trust Deed

- Affirmative VS. negative covenants
 - Affirmative covenants: are typically administrative in nature.
 - ✓ Frequently used affirmative covenants include what the issuer will do with the proceeds from the bond issue and the promise of making the contractual payments.
 - Negative covenants: frequently costly and do materially constrain the issuer's potential business decisions.
 - ✓ The purpose of negative covenants is to protect bondholders from such problems as the dilution of their claims, asset withdrawals or substitutions, and suboptimal investments by the issuer.

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Taxation of Bond Income

- Tax consideration:
 - Interest income paid to bondholders is taxed as ordinary income at the same rate as wage and salary income.
 - ✓ Municipal debts is most often exempt from federal income tax and from the income tax of the state.
 - ✓ The tax status of bond income depend on where the bond is issued and traded.
 - Capital gain or loss: due to sell a coupon bond prior to maturity
 - ✓ Capital gains are taxed at a lower rate than ordinary income.
 - ✓ Long-term CG: capital gains on the sale of an asset that has been owned for more than the minimum amount of time, which is taxed at an even lower rate.
 - Original issue discount (OID) bonds: a portion of the discount from par at issuance is treated as taxable interest income each year.
 - ✓ This tax treatment also allows that the tax basis of the OID bond is increased each year by the amount of interest income recognized, so there is no additional capital gains tax liability at maturity.
 - ✓ Pure-discount bonds: a portion of the discount from par at issuance is treated as taxable interest income.
 - Premium bonds: part of the premium can be used to reduced the taxable portion of interest payments.

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Cash Flow Structure

2015.06 (1)

- Principal repayment structures
 - Plain vanilla bond/bullet bonds: periodic interest payments and principal is paid at maturity.
 - ✓ Balloon payment
 - Amortizing loan: periodic payments include both interest and some repayment of principal.
 - ✓ Fully amortizing: principal is fully paid off when the last periodic payment is made.
 - ✓ Partially amortizing: the final payment includes just the remaining unamortized principal amount at bond maturity.

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Cash Flow Structure

2015.06 (1)

- The sinking fund provision is used to reduce the credit risk of the issuer.
- Sinking fund provision: requires the issuer to retire a portion of a bond issue at specific times during the bonds' life.
 - Originally, a sinking fund was a specified cash reserve that was segregated from the rest of the issuer's business for the purpose of repaying the principal.
 - More generally today, a sinking fund arrangement specifies the portion of the bond's principal outstanding, perhaps 5%, that must be repaid each year throughout the bond's life or after a specified date.
 - Advantages: less credit risk due to the periodic redemptions of the principal
 - Disadvantages: more reinvestment risk. when interest rate decreases, the market price is greater than the redemption price
 - ✓ First, investors face reinvestment risk, the risk associated with having to reinvest cash flows at an interest rate that may be lower than the current yield to maturity.
 - ✓ Another potential disadvantage for investors occurs if the issuer has the option to repurchase bonds at below market prices.

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Cash Flow Structure

2014.06 (1)

- **Coupon payment structures**
 - Floating-rate notes
 - Deferred coupon bonds
 - Step-up coupon bonds
 - Credit-linked coupon bonds
 - Payment-in-kind coupon bonds
 - Index-linked bonds 2014.12 (1)

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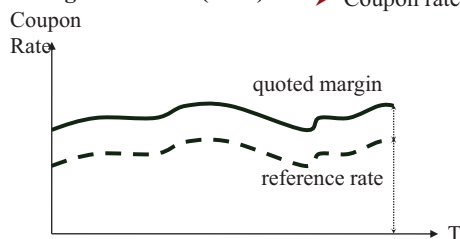
Cash Flow Structure

2015.12 (1) 2015.06 (1)

Coupon payment structures

Floating-Rate Notes (FRN)

$$\text{Coupon rate} = \boxed{\text{reference rate}} \pm \boxed{\text{quoted margin}}$$



- Such as:
 - LIBOR;
 - U.S. Treasury yield

- It is a constant value.
- It is often quoted in basis point.
- Occasionally, the spread is not fixed, called variable-rate note.

- The coupon rate determined at the coupon reset date is the rate that the issuer promises to pay at the **next** coupon date.
 - The new 1-year rate at that time will determine the rate of interest paid at the end of the next year. Most floater pay quarterly and are based on a quarterly (90-day) reference rate.
 - The reference rate must match the frequency with which the coupon rate on the bond is reset.

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Cash Flow Structure

➤ Cap and floor

- The upper limit is called the cap.
- The lower limit is called the floor.
- When a floating-rate security has both a upper limit and a lower limit, the feature is called a collar.

➤ Inverse floaters (also called reverse floaters) have coupon rates that move in the opposite direction from the change in the reference rate.

- When the reference rate increases, the coupon rate decreases and vice versa.

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Cash Flow Structure

➤ TIPS: pay semiannual coupons, at maturity:

- If adjusted par value (per bond) is greater than \$1,000 at maturity, the holder receives the adjusted par value as the maturity payment.
- If the adjusted par value is less than \$1,000 (due to deflation), holders receive \$1,000 at maturity as this is the minimum repayment amount.

$$\text{TIPS coupon payment} = \text{inflation-adjusted par value} \times \frac{\text{stated coupon rate}}{2}$$

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Bonds with Embedded Options

2015.12 (2) 2015.06 (1)

2014.12 (1) 2014.06 (1)

➤ Call provisions are **beneficial to the issuer**.

- Callable bond offers a higher yield (lower price) than identical noncallable bond
 - ✓ Value callable bond = value of identical noncallable bond - call option value

➤ If interest rates fall

- Issuer can retire the bond, and replace it with lower coupon bonds.

➤ Three styles of exercise for callable bonds:

- American style: can be called anytime after the first call date.
- European style: can only be called on the call date specified.
- Bermuda style: can be called on specified dates after the first call date, often on coupon payment dates.

➤ Reinvestment risk about callable bond

➤ The price appreciation of callable bond is limited.

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Bonds with Embedded Options

- Putable bonds are beneficial to the bondholders.
 - If interest rates rise
 - ✓ The bondholders can sell the bond back to the issuer and get cash.
 - ✓ When the bond is put, the proceeds can be reinvested at a higher interest rate.
 - Putable bonds have a lower yield and higher price than similar non-putable bonds.
 - ✓ Value of putable bonds = value of an identical nonputable bonds + put option value.

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Bonds with Embedded Options

2014.12 (1)

- Convertible bonds are beneficial to the bondholders.
- Key terms of conversion provision:
 - Conversion price: share price when the convertible bond can be converted into shares.
 - Conversion ratio: the number of common shares each bond can be converted into.
 - ✓ Conversion ratio = par value / conversion price
 - Conversion value: value of conversion bond if converted right now.
 - ✓ Conversion value = current share * conversion ratio
 - Conversion premium: difference between the convertible bond's price and conversion value
 - Conversion parity:
 - ✓ Conversion value = convertible bond's price
 - ✓ Above parity: conversion value > convertible bond's price
 - ✓ Below parity: conversion value < convertible bond's price

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Bonds with Embedded Options

2014.06 (1)

Embedded options favor the **issuers**:

- The right to call the issue.
- The prepayment option.
- Accelerated sinking fund provision.
- The cap on a floater.

Embedded options favor the **bondholders**:

- Conversion provisions.
- The put option.
- The floor on a floater.

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Framework of Fixed Income

➤ Study Session 15 — Basic Concepts

- R52 Fixed-Income Securities: Defining Elements
- R53 Fixed-Income Markets: Issuance, Trading, and Funding
- R54 Introduction to Fixed-Income Valuation
- R55 Introduction to Asset-Backed Securities

➤ Study Session 16 — Analysis of Risk

- R56 Understanding Fixed-Income Risk and Return
- R57 Fundamentals of Credit Analysis

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Framework

- Classification of fixed-income markets
- Issuing & Trading
- Funding

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Classification of Global Fixed-Income Markets

- By type of issuer:
 - Government and government-related sector
 - Corporate sector
 - ✓ Financial company
 - ✓ Non-financial company
 - Securitized sector
- By credit quality:
 - Investment grade
 - ✓ Baa3 or above by Moody's Investors Service
 - ✓ BBB- or above by Standard & Poor's (S&P) and Fitch Ratings
 - Non-investment grade/high yield
- By original maturity
- By coupon structure
- By currency
- By geography

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Primary Market

2014.12 (1)

- **Primary market:** sales of newly issued bonds
 - **Public offering:**
 - ✓ **Underwritten offering:** with the investment bank or syndicate purchasing the entire issue and selling the bonds to dealers.
 - ✓ **Best efforts offering:** investment bank sells the bonds on a commission basis and do not commit to purchase the whole issue.
 - ✓ Auction
 - ✓ **Shelf registration**
 - **Private placement:** sale of an entire issue to a qualified investor or a group of investors, which are typically large institutions.
- **Secondary markets:** trade of previously issued bonds.
 - **Exchange market:** transaction must obey the rules imposed by the exchange.
 - **OTC Dealer Market** (largest): dealers post bid and ask price.
 - ✓ Spread between bid and ask prices are narrower (wider) for liquid (less liquid) issues
 - Electronic Trading Network (growth)

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Characteristics of Different Kinds of Bonds

- **Sovereign bonds:** issued by national governments and backed by their tax power.
 - High credit ratings and essentially free of default risk. 2014.06 (1)
 - Denominated in the local currency or a foreign currency.
- **Nonsovereign government bonds:** issued by governments below the national level.
 - High credit quality, but lower than sovereign bonds
- **Municipal bond (in the U.S.)**
 - **GO (general obligation)/Tax-Backed Debt** : Support by taxing power of local government
 - ✓ Almost no credit risk
 - ✓ Require voter approval
 - **Revenue Bonds**
 - ✓ Supported only through revenues generated by projects.
 - ✓ Involve more risk, provide higher yield.
- **Agency/quasi-government bonds:** issued by entities created by national government and may be explicitly or implicitly backed by government. 2014.12 (1)

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Types of Corporation Debts

2015.06 (1)

2014.06 (1)

- **Commercial paper:** short term, unsecured, low rate (issued by corporations of high credit quality) debt.
 - Exempt from registration, directly placed (sold directly by issuer) or dealer placed (sold to investor through agents/brokers).
 - There is very little secondary trading of commercial paper.
 - Reissued or rolled over when it matures.
 - **Rollover risk:** the risk that a company will not be able to sell new commercial paper to replace maturing paper.
 - **U.S commercial paper Vs. Euro-commercial paper**

| Feature | U.S commercial paper | Eurocommercial paper |
|------------|---|---------------------------------------|
| Currency | U.S dollar | Any currency |
| Maturity | Overnight to 270 days | Overnight to 364 days |
| Interest | Discount basis (pure discount security) | Interest-bearing basis (add-on yield) |
| Settlement | T+0 | T+2 |
| Negotiable | Can be sold to another | Can be sold to another |

30-88

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Types of Corporation Debts

➤ Corporate bonds

- Serial bond issue: with several maturity dates (known at issuance) and can be redeemed periodically.
- Term maturity structure: all the bonds maturing on the same date.

➤ Medium-term notes (MTNs): 2015.06 (1)

- Various maturities(9 months to 100 years)
- Can be structured to meet an institution's specifications.
- ✓ E.g. structured security: combination of the derivative and notes

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Repurchase Agreement

2015.06 (1)

2014.12 (1)

- **Repurchase (repo) Agreement:** an institution sells a security with a commitment to buy it back at a later date at a specified price.
 - Repurchase agreements are not regulated by the Federal Reserve.
 - Collateral position of the lender in a repo is better in the event of bankruptcy of the dealer. (liquidity)
- **Reverse repo agreement:** taking the opposite side of a repurchase transaction, lending funds by buying the collateral security.
- **Repo rate:** is the interest rate on a repurchase agreement. The repo rate is lower when:
 - Repo term is shorter
 - Credit quality of the collateral security is higher
 - Collateral security is delivered to the lender
 - Interest rate for alternative sources of funds are lower
- **Repo margin/hairecut:** the difference between the market value of the security used as collateral and the value of the loan. The repo margin is lower when:
 - Repo term is shorter
 - Credit quality of the collateral security is higher
 - Credit quality of the borrower is higher
 - Collateral security is in high demand or low supply.

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Framework of Fixed Income

➤ Study Session 15 — Basic Concepts

- R52 Fixed-Income Securities: Defining Elements
- R53 Fixed-Income Markets: Issuance, Trading, and Funding
- R54 Introduction to Fixed-Income Valuation
- R55 Introduction to Asset-Backed Securities

➤ Study Session 16 — Analysis of Risk

- R56 Understanding Fixed-Income Risk and Return
- R57 Fundamentals of Credit Analysis

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Framework

- Bond valuation
 - Bond pricing with a market discount rate
 - The value of a zero-coupon bond
- Yield-to-maturity
- The value change attributable to the passage of time
- Pricing bonds with spot rate
- Full price, clean price, accrued interest
- Matrix pricing
- Yield measure
 - Yield measures for fixed-rate bonds
 - Yield measures for floating-rate notes
 - Yield measures for money market instruments
- Yield curve
- Yield spread

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Yield to Maturity (YTM)

2014.12 (1)

2014.06 (1)

- Internal rate of return, implied market discount rate
- Critical assumptions:
 - hold the bond until maturity
 - full, timely coupon, principal payments (no default)
 - coupons are reinvested at original YTM
- Calculation: iteration, back out

- Annual -coupon bond

$$\text{bond price} = \frac{CPN_1}{(1 + YTM)} + \frac{CPN_2}{(1 + YTM)^2} + \dots + \frac{CPN_N + \text{Par}}{(1 + YTM)^N}$$

- Semiannual-coupon bond:

$$\text{bond price} = \frac{CPN_1}{(1 + YTM/2)} + \frac{CPN_2}{(1 + YTM/2)^2} + \dots + \frac{CPN_{2N} + \text{Par}}{(1 + YTM/2)^{2N}}$$

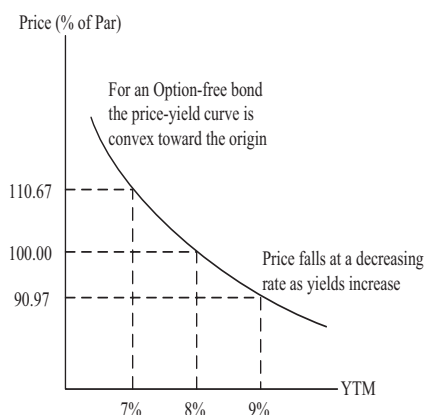
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Relationships Between Price and Time

- A bond's price and YTM are inversely related.
- A bond will be priced at a discount (premium) to par value if coupon rate is less (more) than its YTM.
- For a given change in yield, the percentage price increase is greater than the percentage price decrease.



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Relationships Between Price and Time

2015.06 (1)

➤ Consider a \$100 par value bond with a 7% coupon paid annually and 5 years to maturity. At a discount rate of 6.5%, the value of the bond today is \$102.08. One day later, the discount rate rises to 7.5%. Assuming the discount rate remains at 7.5% over the remaining life of the bond, what is most likely to occur to the price of the bond between today and maturity?

A. Increases then decreases

B. Decreases then increases

C. Decreases then remains unchanged

➤ **B is correct.**

37-88

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Relationships Between Price and Time

2014.06 (1)

➤ Consider a \$100 par value bond with a 7 percent coupon paid annually and 5 years to maturity. At a discount rate of 6.0 percent, the value of the bond is \$104.21. One year later, the appropriate discount rate has risen to 6.5 percent and the bond's value is \$101.71. What part of this change in value is most likely attributable to the passage of time?

A. \$0.37

B. \$0.74

C. \$1.76

➤ **Solution: B**

With 4 years remaining to maturity and a discount rate that is unchanged at 6.0 percent, the value of the bond would be \$103.47 or

N=4, I/Y=6, PMT=7, FV=100, CPT(PV)=103.47

The value change attributable to the passage of time = 104.21 – 103.47 = 0.74

38-88

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Arbitrage-Free Valuation

2014.12 (1)
2014.06 (1)

➤ Using the U.S. Treasury spot rates provided below, the arbitrage-free value of a 2-year Treasury, \$100 par value bond with a 6% coupon rate is closest to:

| Period | Years | Spot Rate |
|--------|-------|-----------|
| 1 | 0.5 | 1.60% |
| 2 | 1.0 | 2.20% |
| 3 | 1.5 | 2.70% |
| 4 | 2.0 | 3.10% |

A. \$99.75.

B. \$105.65.

C. \$107.03.

➤ **B is correct.**

$$\frac{3}{(1 + 0.0160 / 2)^1} + \frac{3}{(1 + 0.0220 / 2)^2} + \frac{3}{(1 + 0.0270 / 2)^3} + \frac{103}{(1 + 0.0310 / 2)^4} = 105.65$$

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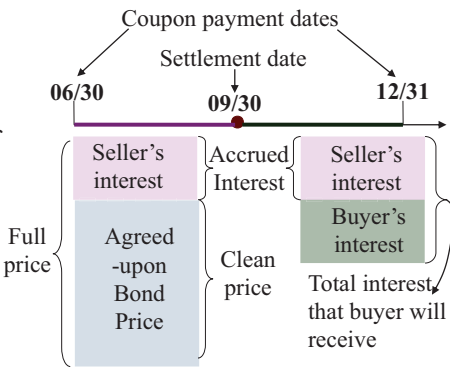
Accrued Interest, Full Price, Clean Price

2015.12 (1) 2015.06 (1)

➤ **Accrued Interest:** the interest received by the seller when a bond trades between coupon dates.

➤ **Clean(flat) Price:** the agreed upon price of the bond.

➤ **Full Price (or dirty price):** the amount that the buyer pays to the seller, which equals the clean price plus any accrued interest.



$$\text{Full Price} = \text{Clean Price} + \text{Accrued Interest}$$

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Example

2015.12 (1) 2014.06 (1)

➤ Bond G, described in the exhibit below, is sold for settlement on 16 June 2014. Calculate the **clean price** that Bond G will settle at on 16 June 2014

| | |
|--------------------------|-------------------------|
| Annual Coupon | 5% |
| Coupon Payment Frequency | Semiannual |
| Interest Payment Dates | 10 April and 10 October |
| Maturity Date | 10 October 2016 |
| Day Count Convention | 30/360 |
| Annual Yield-to-Maturity | 4% |

➤ Answer:

● The bond's full price is determined in the following manner: As of the beginning of the coupon period on 10 April 2014, there are 2.5 years to maturity. These five semiannual periods occur on 10 October 2014, 10 April 2015, 10 October 2015, 10 April 2016 and 10 October 2016.

$$\text{PMT}=2.5, \text{I/Y}=2, \text{N}=5, \text{FV}=100, \text{CPT PV}=102.36$$

$$P_{\text{full}} = 102.36 \times (1.02)^{\frac{66}{180}} = 103.10$$

$$\text{Accrued interest} = 2.5 \times \frac{66}{180} = 0.92$$

$$P_{\text{clean}} = 103.10 - 0.92 = 102.18$$

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Matrix Pricing

2014.12 (1) 2014.06 (1)

➤ **Matrix pricing:** a method of estimating the required YTM of bonds that are currently not traded or infrequently traded bonds according to the yields of traded bonds with the same credit quality.

➤ **Linear interpolation** can be used when the maturities between the valued bond and the traded bond are different.

Example:

➤ An analyst needs to assign a value to an illiquid four-year, 4.5% annual coupon payment corporate bond. The analyst identifies two corporate bonds that have similar credit quality: One is a three-year, 5.5% annual coupon payment bond priced at 107.500 per 100 of par value, and the other is a five-year, 4.5% annual coupon payment bond priced at 104.750 per 100 of par value. Using matrix pricing, the estimated price of the illiquid bond per 100 of par value is closest to:

- A. 103.895
- B. 104.991
- C. 106.125

B is correct.

42-88

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Yield measures for floating-rate notes

2014.12 (1)

- Coupon rate = reference rate + **quoted margin**
 - **Quoted margin:** margin used to calculate the bond coupon payments
- Discount rate = reference rate + **required margin (or discount margin)**
 - **Required/discount margin:** margin required to return the FRN to its par value at each reset date.
 - ✓ Selling at par(credit unchanged): required margin = quoted margin
 - ✓ Selling at discount(downgrade of credit): quoted margin < required margin
 - ✓ Selling at premium(upgrade of credit): quoted margin > required margin
- A two-year floating-rate note pays 6-month Libor plus 80 basis points. The floater is priced at 97 per 100 of par value. Current 6-month Libor is 1.00%. Assume a 30/360 day-count convention and evenly spaced periods. The discount margin for the floater in basis points (bps) is closest to:
 - A. 180 bps.
 - B. 236 bps.
 - C. 420 bps.
- **Correct answer: B**

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Introduction to Fixed-Income Valuation

- Yield measures for money market instruments
 - Discount yield: (e.g., U.S. Treasury bills) $PV = FV \times \left(1 - \frac{\text{Days}}{\text{Year}} \times DR\right)$ 2015.06 (1)
 - Add-on yield: (e.g., LIBOR, bank CD rates) $PV = \frac{FV}{\left(1 + \frac{\text{Days}}{\text{Year}} \times AOR\right)}$ 2014.06 (1)
 - Both discount basis and add-on yields in the money market are quoted as simple annual interest and can be based on a 360-day or 365-day basis.
 - **Bond equivalent yield** (investment yield) for money market security: yield stated on a 365-day add-on rate basis.
- **Current yield(income or interest yield):** not consider capital gains/loss or reinvestment income $\text{current yield} = \frac{\text{annual coupon}}{\text{price}}$
- **Yield to call (put)** is calculated as a **YTM** but with the number of periods until the call (put) price substituted for the number of periods to maturity and the maturity value.

2014.12 (1)

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Yield Curve

2014.12 (1)

- **Yield curve** shows the term structure of interest rates by displaying yields across different maturities.
- **Spot curve:** a yield curve for single payments in the future, such as zero-coupon bonds or stripped Treasury bonds.
 - Spot curve for U.S. Treasury bonds is called the zero-curve or strip curve.
- **Yield curve for coupon bonds** shows the YTM for coupon bonds at various maturities, which can be calculated by linear interpolation
- **Par bond yield curve:** shows the coupon rates for bonds of various maturities that would result in bond prices equal to their par values.

Example:

- Consider a 3-year annual-pay bond with spot rates of 1%, 2%, 3%, the coupon payment satisfies:

$$\frac{PMT}{1.01} + \frac{PMT}{(1.02)^2} + \frac{PMT+100}{(1.03)^3} = 100$$

Solution: PMT=2.96, par bond coupon rate=2.96%

- **Forward yield curve** shows the future rates for bonds or money market securities for the same maturities for annual periods in the future.

45-88

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Forward Rates vs. Spot Rates

2015.12 (1) 2015.06 (1)

➤ **Forward Rates:** borrowing/lending rate for a loan to be made at some future date. Marginal return for extending the time-to-maturity for an additional period

- E.g. The int. of a 1-year loan that would be made 2 years from now
- Notation: 2y1y rate of a 1-year loan to be made 2 years from now

➤ **Relationship Between Forward Rates and Spot Rates**

$$(1 + S_T)^T = (1 + S_1)(1 + 1y1y) \dots (1 + (T - 1)y1y)$$

➤ **Valuation Using Forward Rates**

$$\text{bond value} = \frac{CF_1}{(1 + S_1)} + \frac{CF_2}{(1 + S_1)(1 + 1y1y)} + \dots + \frac{CF_n}{(1 + S_1)(1 + 1y1y) \dots (1 + (T - 1)y1y)}$$

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Yield Spread

2015.06 (1)

2014.06 (1)

➤ **Benchmark spread:** a yield spread relative to a benchmark bond.

- G-spread: the benchmark is government bond yield
- Interpolated spread (I-spread): the benchmark is swap rate
- Zero-volatility spread (Z-spread): the spread that must be added to each rate on the benchmark yield curve to make the present value of a bond equal to its price.

➤ The difference between the GS and the ZS

- The steeper the benchmark spot rate curve, the greater the difference between the two spread measures.
- The earlier bond principal is paid, the greater the difference between the two spread measures

➤ **Option-adjusted spread (OAS):** used for bonds with embedded options.

- Callable bond: $ZS > OAS$
- Puttable bond: $ZS < OAS$

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Example

2014.06 (1)

| Bond | Coupon rate | Time-to-maturity | Price |
|--------------------------------|-------------|------------------|--------|
| U.K. Government Benchmark Bond | 2% | 3 years | 100.25 |
| U.K. Corporate Bond | 5% | 3 years | 100.65 |

➤ Both bonds pay interest annually. The current three-year EUR interest rate swap benchmark is 2.12%. The G-spread in basis points (bps) on the U.K. corporate bond is closest to:

- 264 bps.
- 285 bps.
- 300 bps.

➤ **Answer:** B

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Framework of Fixed Income

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Framework

- Securitization
- Mortgage-Backed Securities (MBS)
 - Residential Mortgage Loans
 - Residential Mortgage-Backed Securities (RMBS)
 - ✓ Agency MBS
 - ◆ Mortgage passthrough security (MPS)
 - Weighted average maturity (WAM)
 - Weighted average coupon (WAC)
 - ◆ Prepayment risk
 - ◆ Structure of CMO
 - Sequential pay CMO
 - PAC & support tranche
 - Floating-rate tranche
 - ✓ Non-agency MBS
 - Commercial Mortgage-Backed Securities (CMBS)
 - Non-Mortgage Asset-Backed Securities (ABS)
 - Collateralized Debt Obligations (CDO)

50-88

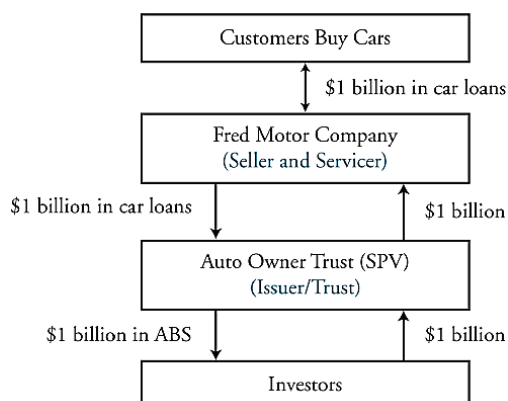
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Parties Involved in the Process of Securitization

2015.06 (1)

- Parties involved in the process of securitization and their functions:
 - The seller (Fred) originates the auto loans and sells the portfolio of loans to Auto Loan Trust, the SPE.
 - The issuer/trust (Auto Loan Trust) is the SPE that buys the loans from the seller and issues ABS to investors.
 - The servicer (Fred) services the loans.
 - In this case, the seller and the servicer are the same entity (Fred Motor Company), but that is not always the case.



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Residential Mortgage Loans

- Rights of the lender in a foreclosure
 - **Recourse loan:** the lender has a claim against the borrower for the shortfall between the amount of the mortgage balance outstanding and the proceeds received from the sale of the property.
 - ✓ Residual mortgage in most European countries are recourse loan
 - **Nonrecourse loan:** the lender does not have such a claim, so the lender can look only to the property to recover the outstanding mortgage balance.
 - ✓ In the United States, residential mortgages are typically non-recourse loans.
- **Strategic default:** the borrower has an incentive to default and allow the lender to foreclose on the property if the value of the property declines below the amount owed by the borrower, even if resources are available to continue to make mortgage payments

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Residential Mortgage-Backed Securities

Government National Mortgage Association (Ginnie Mae)

- Federal-related institution, its guarantees carries the full faith and credit of the U.S. government

Federal Home Loan Mortgage Corporation (Freddie Mac)

- Freddie Mac and Fannie Mae are government sponsored enterprises. Their guarantee does not carry the full faith and credit of the government.

Federal National Mortgage Association (Fannie Mae)

- The pass-through securities issued by Fannie and Freddie are called conventional pass-through securities

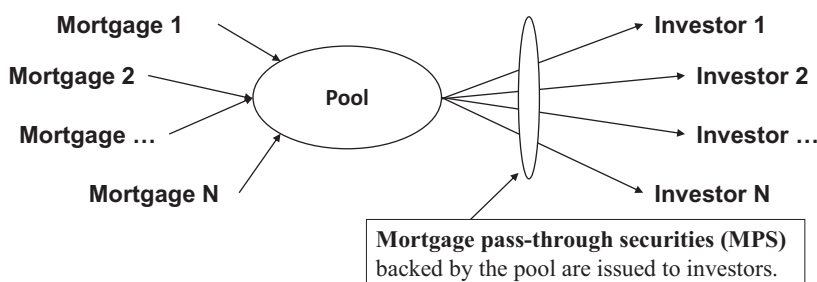
- If a loan satisfies the underwriting standards for inclusions as collateral for an agency MBS, it is called a *conforming mortgage*.
- *Nonconforming mortgage pass-through securities* are issued by thrifts, commercial banks, and private conduits

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Residential Mortgage-Backed Securities



- **Pass-through rate**
 - Pass-through rate is less than the mortgage rate on the underlying pool of mortgages by servicing and guaranteeing fees
 - **Mortgage rate – Pass-through rate = Servicing fees**

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Residential Mortgage-Backed Securities

➤ Type of prepayment risk

- **Contraction risk** occurs as interest rates fall, prepayment rates increase, the security will have a shorter maturity than was anticipated at the time of purchase because of refinancing at now-available lower rate.
 - ✓ The proceeds received must now be invested at lower interest rates
 - ✓ Price appreciation is not as great as that of an otherwise identical bond that does not have a prepayment or call option
 - ✓ **Contraction risk** occurs as mortgage rates fall, prepayment rates increase, and the average life of the pass-through security decreases.

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Residential Mortgage-Backed Securities

- **Extension risk** occurs as interest rates rise, prepayment rates slow, and the security becomes longer in maturity than anticipated at the time of purchase because investors are reluctant to give up the benefits of a contractual interest rate that now looks low.
 - ✓ The value of the security has fallen because interest rates are higher
 - ✓ Income they receive can potentially reinvest is typically limited to the interest payment and scheduled principal repayments
 - ✓ **Extension risk** occurs as mortgage rates rise, prepayment rates slow, and the average life of the pass-through security increase.

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Residential Mortgage-Backed Securities

➤ Prepayment rates

- Two industry conventions have been adopted as benchmarks for prepayment rates: the **conditional prepayment rate (CPR)** and the **Public Securities Association (PSA)** prepayment benchmark.
 - ✓ CPR is **the annual rate** at which a mortgage pool balance is assumed to be prepaid during the life of the pool.

The PSA standard benchmark: 100% PSA

- CPR=0.2% for the first month after origination, increasing by 0.2% per month up to 30 months. For example, the CPR in month 14 is 2.8%.
- CPR=6% for months 30 to 360
- After 30 months, no prepayment rate is added.

➤ **Monthly prepayment rate:** single monthly mortality rate (SMM)

$$SMM = \frac{\text{Prepayment for month}}{(\text{Beginning mortgage balance for month} - \text{scheduled principal repayment for month})}$$

$$SMM = 1 - (1 - CPR)^{1/12}$$

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Collateralized Mortgage Obligations (CMO)

➤ *Creating collateralized mortgage obligations (CMOs)*

- **CMOs** are securities issued against pass-through securities for which the cash flows have been reallocated to different tranches.
- Each CMO tranche represents a different mixture of contraction and extension risk.
- Redistribution of the original passthrough securities' cash flows does not eliminate contraction and extension risk.

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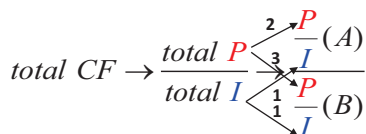
Collateralized Mortgage Obligations (CMO)

2015.06 (1)

➤ *Different types of CMOs*

➤ 1. Sequential Pay tranches

- Each class of bonds is retired sequentially in sequential pay CMO.



- Contraction and extension risk still exist with this structure, but they have been redistributed to some extent between the two tranches.
- The short tranche, which matures first, offers relatively more protection against extension risk. The other tranche provides more protection against contraction risk.

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Collateralized Mortgage Obligations (CMO)

2015.12 (1)

2015.06 (1)

➤ 2. PAC and support

- A PAC is a tranche that is amortized based on a sinking fund schedule that is established within a range of prepayment speeds called the **initial PAC collar**.
- There is a principal repayment schedule that must be satisfied.
- **PAC bondholders have priority over all other classes** in the CMO structure in receiving principal payments from the collateral.
- The greater certainty of the cash flow for the PAC bonds comes at the expense of the non-PAC tranches (**support tranches**). It is these tranches that **absorb the prepayment risk**.
- PAC tranches have **protection against both extension risk and contraction risk**, providing two-sided prepayment protection.
- When the support tranches will eventually be paid off, and the principal will then go to the PAC holders, and the PAC is referred to as **a broken or busted PAC**.

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Collateralized Mortgage Obligations (CMO)

| Average Life Variability of PAC I Tranche vs. Support Tranche | | |
|---|---------------|-----------------|
| PSA Speed | PAC I Tranche | Support Tranche |
| 0 | 13.2 | 24.0 |
| 50 | 8.8 | 21.2 |
| 100 | 6.5 | 17.1 |
| 150 | 6.5 | 13.3 |
| 200 | 6.5 | 10.4 |
| 250 | 6.5 | 5.2 |
| 300 | 6.5 | 2.9 |
| 350 | 5.9 | 2.4 |
| 400 | 5.4 | 1.8 |
| 450 | 4.6 | 1.5 |
| 500 | 4.2 | 1.2 |

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Non-agency RMBS

- Non-agency RMBS: RMBS issued by entities other than Ginnie Mae, Fannie Mae, and Freddie Mae
- Differences between Agency and Non-agency securities
 - **Agency securities:** CMOs are created from pools of passthrough securities.
 - **Non-agency securities:** CMOs are created from unsecuritized mortgage loans.
 - Non-agency securities have no explicit or implicit government guarantee of payment of interest and principal as agency securities have.
 - All non-agency securities are **credit enhanced**: external and internal.

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Commercial mortgage-backed securities (CMBS)

2015.06 (1)

- CMBS are **no recourse loans**; the lender can only look to the collateral (income-producing property) as means to repay a delinquent loan
- **Call protection**
 - **Loan-level call protection**
 - ✓ **Prepayment lock out.** For a specific period of time (typically two to five years), the borrower is prohibited from prepaying the mortgage loan.
 - ✓ **Defeasance.** Should the borrower insist on making payments on the mortgage loan, the mortgage loan can be defeased, which means the loan proceeds are received by the loan servicer and invested in U.S. Treasury securities, essentially creating cash collateral against the loan.
 - ✓ **Prepayment penalty points.** A penalty fee may be charged if the borrower prepays the mortgage loan.
 - ◆ In many cases, this penalty fee is quoted as a 5-4-3-2-1, which means the penalty fee is 5% of the principal amount of the loan in the first year, and 1% of the principal amount if repaid in the fifth year of the mortgage.
 - ✓ **Yield maintenance charges.** The borrower is charged the amount of interest lost by the lender should the loan be prepaid.
 - **CMBS-level call protection**
 - ✓ CMBS loan pools are segregated into **tranches** with a specific sequence of repayment.
 - ✓ Those tranches with a higher priority for prepayment or collateral position will have a higher credit rating than lower priority tranches.

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Commercial mortgage-backed securities (CMBS)

➤ Balloon maturity provisions

- Balloon loans require substantial principal payment at the end of the term of the loan
- If the borrower fails to make the balloon payment, the borrower is in default. (**balloon risk**)
- Balloon risk is a type of **extension risk**.

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Non-Mortgage Asset-backed Securities (ABS)

Non-Mortgage Asset-backed Securities (ABS)

➤ 1. Auto Loan ABS

- Auto loan market is tiered based on the credit quality of the borrowers.
 - ✓ Short-term nature
 - ✓ Major issuers of auto loans have tended to follow prudent underwriting standards
- Auto loans prepay if the cars sold, traded in, repossessed, stolen, wrecked, or the loan is paid off from insurance proceeds, the borrower may simply use excess cash to prepay
- Refinancing is not a major factor contributing to prepayment
 - ✓ Loan balances are small, the automobile's value may depreciate faster in early years
 - ✓ Prepayment is more predictable and less dependent on interest rate change

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Non-Mortgage Asset-backed Securities

2015.12 (1)

➤ 2. Credit Card Receivable-backed securities: credit card receivables are used as collateral for the issuance, **non-amortizing loans**.

- For a pool of credit receivables, the cash flows consist of:
 - ✓ **Finance charges collected**: represent the periodic interest the credit card borrower is charged on the unpaid balance after the grace period.
 - ✓ **Fees**: include late payment fees and any annual membership fees.
 - ✓ **Principal repayments**: “early amortization” or “rapid amortization” provisions included to safeguard the credit quality of the issue.
- **Lockout periods**: cash flow paid out based only on finance charges collected and fees.
 - ✓ **After lockout periods**: principal no longer reinvested but paid to investors.

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Collateralized debt obligation (CDO)

2015.06 (1)

➤ Collateralized debt obligation (CDO)

- A collateralized debt obligation (CDO) is a security backed by a diversified pool of one or more of the following types of debt obligations:

| | |
|---|--------------------------------------|
| U.S. domestic high-yield corporate bonds | Collateralized bond obligation (CBO) |
| Structured financial products | |
| Emerging market bonds | |
| Bank loans | Collateralized loan obligation (CLO) |
| Special situation loans and distressed debt | |

- A structure of a CDO

| | |
|----------------------------|--------------------------------|
| Senior tranche | At least A |
| Mezzanine tranche | BBB but no less than B |
| Subordinate/equity tranche | Receive the residual cash flow |

- ✓ In typical structure, one or more of the tranches is a **floating-rate security**.
- ✓ Asset manager uses **interest rate swap** to deal with the mismatch.

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Framework of Fixed Income

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- R57 Fundamentals of Credit Analysis

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Framework

➤ Annualized holding period return

➤ Interest rate risk

- Duration
- Convexity
- Duration gap

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Source of Return

2015.12 (1)

➤ Three sources of return:

- Coupon and principal payments
- Reinvestment of coupon payments
- Capital gain or loss if bond is sold before maturity

➤ Total return: future value of reinvested coupon interest payments and the sale price (par value if the bond is held to maturity)

➤ Annualized holding period return: calculated as the compound annual return earned from the holding period .

$$annualized \text{ holding period return} = \left(\frac{\text{total return}}{\text{bond price}} \right)^{\frac{1}{n}} - 1$$

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Interest Rate Risk

➤ **Interest risk**

- 利率风险：即债券价格对利率变化的敏感程度，价格对利率变化越敏感，价格波动的可能性就越高
- 通常用久期duration来衡量利率风险，久期越高，利率风险越高

$$\text{duration} = - \frac{\text{percentage change in bond price}}{\text{yield change in percent}}$$

$$\text{Percentage price change} = - \text{duration} \times \text{yield change in \%}$$

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Duration

➤ **Duration**: a measure of a bond's interest rate risk or sensitivity of a bond's full price to a change in its yields.

- Yield duration: sensitivity of the bond price with respect to the bond's own yield-to-maturity (Macaulay duration, modified duration, money duration, PVBP)

✓ **Macaulay duration**

$$\text{Macaulay duration} = \frac{\sum_{t=1}^n t \times PVCF_t}{\sum_{t=1}^n PVCF_t (= P_0)} = \sum_{t=1}^n [t \times (PVCF_t / P_0)]$$

✓ **Modified duration**

$$\text{Modified duration} = \frac{\text{Macaulay duration}}{1 + \text{periodic market yield}} \quad 2015.12 (1)$$

✓ **Approximate modified duration**

$$\text{Approximate modified duration} = \frac{V_- - V_+}{2 \times V_0 \times \Delta YTM}$$

$$\Delta P / P \approx - \text{ModDur} \times \Delta YTM$$

- Curve duration: sensitivity of the bond price (or more generally, the market value of a financial asset or liability) with respect to a benchmark yield curve effective duration.(used for bonds with embedded option)

$$\text{Effective duration} = \frac{V_- - V_+}{2 \times V_0 \times \Delta \text{curve}} \quad \begin{array}{ll} 2015.12 (2) & 2015.06 (1) \\ 2014.12 (1) & 2014.06 (1) \end{array}$$

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Money Duration and PVBP

➤ Money duration/dollar duration

2014.06 (2)

Money duration=annual modified duration * full price of bond

➤ Money duration expressed as money duration per 100 of bond par value

Money duration per 100 units of par value

=annual modified duration * full price of bond per 100 of par value

➤ Price value of a basis point (PVBP): is the money change in full price of a bond when its YTM changes by one basis point(0.01%)

2015.12 (1)

2014.06 (1)

$$PVBP = D \times 1bp \times P$$

$$PVBP = \frac{(V_- + V_+)}{2}$$

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Definition of Duration

2015.06 (1)

2014.12 (1)

➤ Interpreting duration:

- Duration is the **slope** of the price-yield curve at the bond's current YTM. (the first derivative of the price-yield curve with respect to yield, but it's not absolutely right for such description)
- Duration is a weighted average of time (in years) until cash flow will be received. The weights are the proportions of the total bond value that each cash flow represents.
- Duration is the approximate percentage change in price of 1% change in yield. (price sensitivity)

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Effects of Bond Characteristics on Duration

2015.06 (1)

2014.12 (1) 2014.06 (1)

➤ Effects of bond characteristics on duration:

- Longer maturity, higher duration.
- Lower coupon, higher duration.
- Lower market yield, higher duration
- Bond with embedded options (callable bond & putable bond) has lower duration.

➤ 注:

- $D_{\text{perpetuity}} = (1 + \text{YTM}) / \text{YTM}$
- $D_{\text{zero-coupon bond}} = M_{\text{zero-coupon bond}}$
- $D_{\text{discount}} > D_{\text{premium}}$
- D_{discount} 随着时间的变化先增加后减小，并不是时间越长，duration越大。

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Portfolio duration

➤ Portfolio duration

2015.12 (1)

2014.12 (1)

$$\text{Portfolio duration} = w_1 D_1 + w_2 D_2 + \dots + w_n D_n$$

- **Limitations:** the measure of portfolio duration implicitly assumes a parallel shift in the yield curve.

2015.06 (1)

2014.06 (1)

- ✓ A parallel yield curve shift implies that all rates change by the same amount in the same direction.
- ✓ In reality, interest rate changes frequently result in a steeper or flatter yield curve. (**non-parallel shifts** → **key rate duration**)

2015.12 (1)

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Convexity

➤ Convexity is a measure of the curvature of the price-yield curve.

$$\text{approximate convexity} = \frac{V_- + V_+ - 2V_0}{(\Delta \text{YTM})^2 V_0}$$

2015.12 (1)

2015.06 (1)

- Effective Convexity:

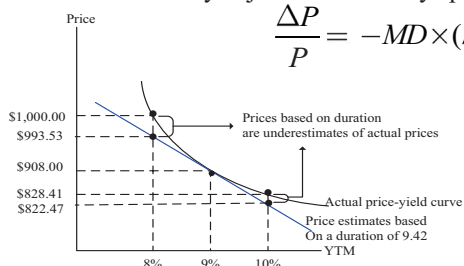
$$\text{effective convexity} = \frac{V_- + V_+ - 2V_0}{(\Delta \text{curve})^2 V_0}$$

- The convexity adjustment is always positive when convexity is positive

$$\frac{\Delta P}{P} = -MD \times (\Delta y) + [0.5 \times \text{Conv} \times (\Delta y)^2]$$

2015.12 (2) 2015.06 (2)

2014.12 (2) 2014.06 (2)



2015.06 (2)
2014.06 (1)

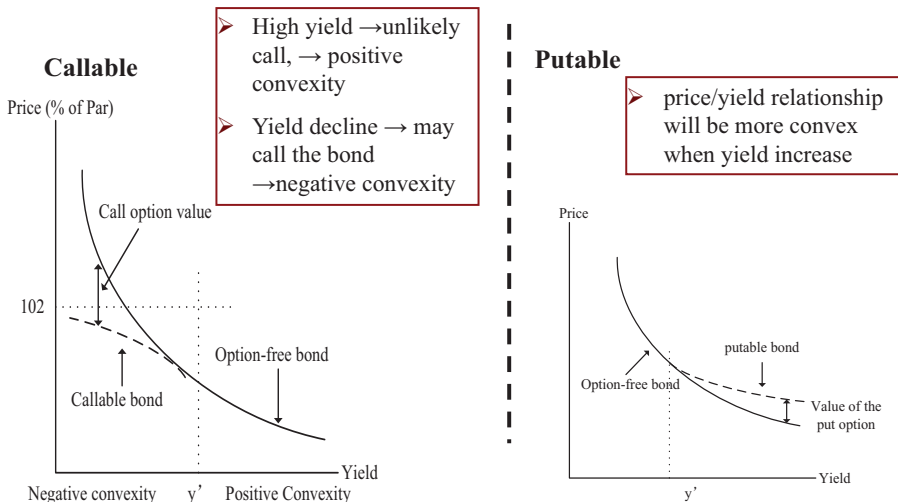
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Convexity

2015.12 (2)



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Duration gap

2015.06 (1)
2014.12 (1) 2014.06 (3)

- Macaulay duration may be interpreted as the investment horizon for which a coupon reinvestment risk and market price risk just offset each other, assuming there's a one-time parallel shift in the yield curve that occurs before the next coupon payment date.
- Relationships among interest rate risk, Macaulay duration, and investment horizon:
 1. if investment horizon > Macaulay duration, then reinvestment risk dominates price risk, investor's risk is to lower interest rates.
 2. if investment horizon = Macaulay duration, then reinvestment risk offsets price risk
 3. if investment horizon < Macaulay duration, then price risk dominates reinvestment risk, investor's risk is to higher interest rates.
- **Duration gap:**

$$\text{Duration gap} = \text{Macaulay duration} - \text{investment horizon}$$

- **Positive gap** exposes the investor to market price risk from increasing interest rates
- **Negative gap** exposes the investor to reinvestment risk from decreasing interest rates

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Framework of Fixed Income

➤ Study Session 15 — Basic Concepts

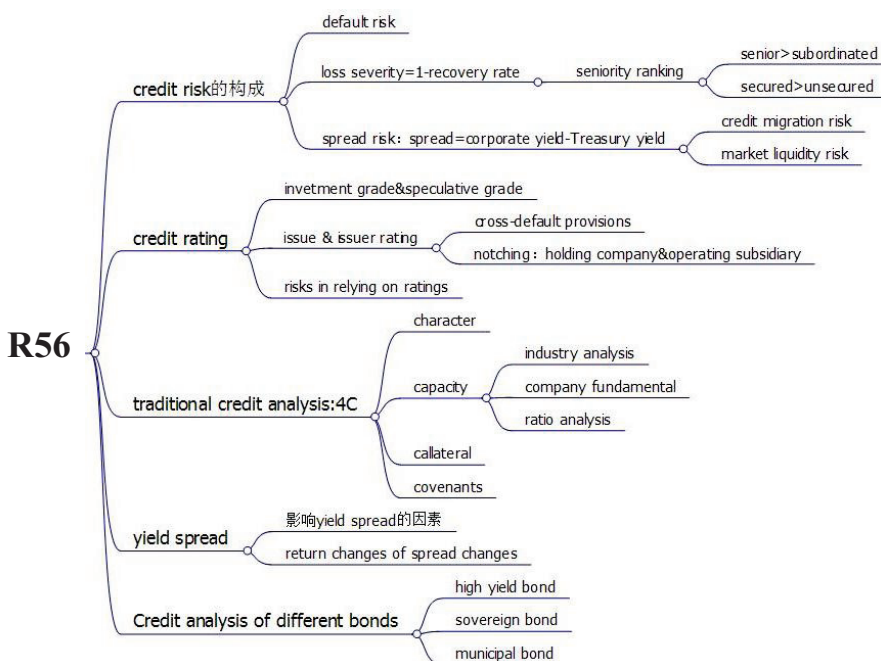
- R52 Fixed-Income Securities: Defining Elements
- R53 Fixed-Income Markets: Issuance, Trading, and Funding
- R54 Introduction to Fixed-Income Valuation
- R55 Introduction to Asset-Backed Securities

➤ Study Session 16 — Analysis of Risk

- R56 Understanding Fixed-Income Risk and Return
- R57 Fundamentals of Credit Analysis

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Fundamentals of Credit Analysis

- **Credit risk** is the risk of loss resulting from the borrower (issuer of debt) failing to make full and timely payments of interest and/or principal. It has two components.
 - **Default risk**, or default probability, is the probability that a borrower defaults – that is, fails to meet its obligation to make full and timely payments of principal and interest, according to the terms of the debt security.
 - **Loss given default**, or loss severity, in the event of default, is the portion of a bond's value (including unpaid interest) an investor loses.
- Expected loss = Default probability * Loss severity given default
 - Loss severity given default = 1 – Recovery rate
 - **Recovery rate** is the percentage of the principal amount recovered in the event of default.

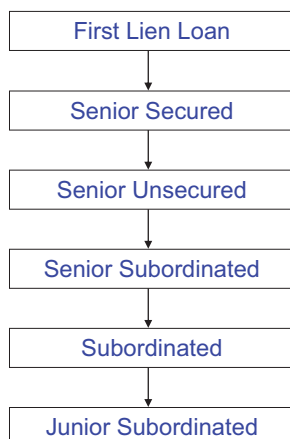
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Fundamentals of Credit Analysis

2014.12 (2)

- **Capital Structure**: the composition and distribution across operating units of a company's debt and equity, including bank debt, bonds of all seniority rankings, preferred stock, and common equity.
- **Seniority Ranking**



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Fundamentals of Credit Analysis

- **Credit rating**
 - Investment grade
 - ✓ Baa3 or above by Moody's Investors Service
 - ✓ BBB- or above by Standard & Poor's (S&P) and Fitch Ratings
 - Non-investment grade/high yield
 - ✓ Below investment grade
- **Issuer credit rating**: address an obligor's overall creditworthiness – its ability and willingness to make timely payments of interest and principal on its debt. 2014.06 (1)
- **Issue ratings** refer to specific financial obligations of an issuer and take into consideration such factors as ranking in the capital structure (e.g., secured or subordinated).
- **Notching** is the practice by rating agencies of assigning different ratings to bonds of the same issuer. 2014.12 (1)
- **Cross default provision**: reduce credit risk.
- **Structural subordination**
 - Subsidiary's debt covenant may restrict the transfer of cash or assets upstream to the parent company before the subsidiary's debt is serviced. Thus the parent company's bonds are effectively subordinated to the subsidiary's bonds.

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Fundamentals of Credit Analysis

2014.06 (1)

➤ Risks in relying on agency ratings:

- **Credit ratings can be very dynamic.**
 - ✓ Creditworthiness can and does change – up or down – and that bond investors should not assume an issuer’s credit rating will remain the same from time of purchase through the entire holding period.
- **Rating agencies are not infallible.**
- **Other types of so-called idiosyncratic or event risk are difficult to capture in ratings.**
- **Ratings tend to lag market pricing of credit.**
 - ✓ Bond prices and credit spreads frequently move more quickly because of changes in perceived creditworthiness than rating agencies change their ratings (or even outlooks) up or down.
 - ✓ For certain speculative-grade credits, two bonds with similar ratings may trade at very different valuations.

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Fundamentals of Credit Analysis

➤ The four Cs of credit analysis

- *Capacity* refers to the ability of the borrower to make its debt payments on time.
- *Collateral* refers to the quality and value of the assets supporting the issuer’s indebtedness.
- *Covenants* are the terms and conditions of lending agreements that the issuer must comply with.
- *Character* refers to the quality of management.

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Fundamentals of Credit Analysis

2015.12 (1)

2014.12 (1)

➤ Factors affect the spreads on corporate bonds:

- **Credit cycle**
 - ✓ The bond market perceives low aggregate credit risk and is generally bullish. Spreads narrow as the credit cycle improves
- **Economic conditions**
 - ✓ Credit spreads narrow as the economy strengthens
- **Financial market performance**
 - ✓ Credit spreads narrow in strong-performing markets overall, including the equity market.
- **Broker-dealer capital**
 - ✓ Yield spreads are narrower when broker-dealers provide sufficient capital but can widen when market-making capital becomes scarce.
- **General market demand and supply**
 - ✓ Credit spreads narrow in times of high demand for bonds.

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It's not an end but just the beginning.

If there is anyone out there who still questions that China is a place where everything is possible, who wonders if the dream of our founders is alive in our time, who doubts what we can achieve, today is the answer.

It's an answer told by the days and the nights in which we shared our views.

Good luck to everybody!