

# PART 1 Quantitative Analysis

## Reading 6 The Time Value of Money

### 利率的组成

无风险利率  $\text{Nominal Risk-free Interest Rate} = \text{Real Risk-free Interest Rate} + \text{Inflation Premium}$

风险资产收益率  $\text{Return of Risky Asset} = \text{Nominal Risk-free Interest Rate} + \text{Risk Premium}$   
 $\text{Risk Premium} = \text{Default premium} + \text{Liquidity premium} + \text{Maturity premium}$

### 计息方式

报价利率  $\rightarrow$  有效年利率 (EAR)  $EAR = \left(1 + \frac{r_s}{m}\right)^m - 1$

$r_s$ : 报价利率;  
 $m$ : 一年内的计息次数。

连续复利  $EAR = e^{r_s} - 1$

### 现值与终值的转换

终值 (FV)  $FV = PV \cdot \left(1 + \frac{r}{m}\right)^{n \cdot m}$   $n$ : 年数

### 年金

永续年金 (Perpetuity Annuity)  $PV = \frac{A}{r}$   $A$ : 每期现金流

## Reading 7 Statistical Concepts and Market Returns

### 均值(Mean)

名称 公式

算术平均 (Arithmetic Mean)  $\mu = \frac{\sum_{i=1}^N X_i}{N}$   $\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$

几何平均 (Geometric Mean)  $G = \sqrt[n]{X_1 X_2 X_3 \cdots X_n}$   
 Periodic Return<sub>compound</sub> =  $\sqrt[n]{(1 + R_1)(1 + R_2) \cdots (1 + R_n)} - 1$

调和平均 (Harmonic Mean)  $X_{\text{Harmonic}} = \frac{N}{\sum_{i=1}^N \frac{1}{X_i}}$

大小关系  $\text{Harmonic Mean} \leq \text{Geometric Mean} \leq \text{Arithmetic Mean}$

加权平均 (Weighted Mean)  $\bar{X}_W = \sum_{i=1}^n w_i X_i$

### 中位数(Median)

$n$ 为奇数 中位数 =  $(n+1)/2$ 位置的数

$n$ 为偶数 中位数 =  $n/2$ 与 $(n+2)/2$ 两个位置上的数的平均值。

## Reading 7 Statistical Concepts and Market Returns

### 绝对离散程度 (Absolute Dispersion)

名称	公式	
分位数 (Quantiles)	$L_y = (n + 1) \frac{y}{100}$	$n$ : 数据个数; $y$ : 百分位点; $L_y$ : 分位数的位置。
极差 (Range)	Range = Maximum Value - Minimum Value	
平均绝对偏离度 (Mean Absolute Deviation (MAD))	$MAD = \frac{\sum_{i=1}^n  x_i - \bar{x} }{n}$	$\bar{x}$ : 样本均值 $n$ : 观察值数量
总体方差 (Population Variance)	$\sigma^2 = \frac{\sum_{i=1}^N (X_i - \mu)^2}{N}$	$\mu$ : 总体均值 $N$ : 总体大小
样本方差 (Sample Variance)	$s^2 = \frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n - 1}$	$\bar{X}$ : 样本均值 $n$ : 样本大小

## Reading 7 Statistical Concepts and Market Returns

### 绝对离散程度 (Absolute Dispersion)

名称	公式	
总体标准差 (Population Standard Deviation)	$\sigma = \sqrt{\frac{\sum_{i=1}^N (X_i - \mu)^2}{N}}$	$\mu$ : 总体均值 $N$ : 总体大小
样本标准差 (Sample Standard Deviation)	$s = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n - 1}}$	$\bar{X}$ : 样本均值 $n$ : 样本大小

### 相对离散程度 (Relative Dispersion)

名称	公式	
变异系数 (Coefficient of Variance)	$CV = \frac{s}{\bar{X}}$	$s$ : 样本标准差 $\bar{X}$ : 样本均值
切比雪夫不等式 (Chebyshev's inequality)	$P(\mu - k\sigma \leq X \leq \mu + k\sigma) \geq 1 - \frac{1}{k^2}$	$\mu$ : 总体均值 $\sigma$ : 总体标准差 $k > 1$

## Reading 8 Probability Concepts

### 概率 (Probability)

名称	公式	
事件发生的概率 (The Probability of Event E)	$0 \leq P(E) \leq 1$	
互斥遍历事件概率之和 (Sum of Probability)	$\sum P(E_i) = 1$	
赔率 (Odds)	Odds for the Event $E = P(E)/(1 - P(E))$ Odds against Event $E = (1 - P(E))/P(E)$	$P(E)$ : 事件E发生的概率
联合概率 (Joint Probability)	$P(AB) = P(A B)P(B)$	$P(AB)$ : A和B同时发生的概率 $P(A B)$ : B发生的情况A发生的概率 $P(B)$ : B发生的概率
独立事件的联合概率 (Joint Probability of Independent Events)	$P(A B) = P(A)$ $P(AB) = P(A)P(B)$	

## Reading 8 Probability Concepts

### □ 概率 (Probability)

名称	公式	
A和B至少有一件事发生的概率 (Probability that at least one event occurs)	$P(A+B) = P(A) + P(B) - P(AB)$	如果A和B互斥, 则 $P(AB)=0$
全概率公式 (Total Probability Rule)	$P(A) = P(A S1)P(S1) + P(A S2)P(S2) + \dots + P(A Sn)P(Sn)$	$S1, S2 \dots Sn$ 互斥且遍历
贝叶斯公式 (Bayes' Formula)	$P(A B) = \frac{P(B A)}{P(B)} \times P(A)$	
期望的全概率公式 (Total Probability Rule for Expected Value)	$E(X) = E(X S1)P(S1) + E(X S2)P(S2) + \dots + E(X Sn)P(Sn)$	$E(X Sn)$ : $Sn$ 发生的情况X的期望值 $S1, S2 \dots Sn$ 互斥且遍历

## Reading 8 Probability Concepts

### □ 协方差和相关性 (Covariance and Correlation)

名称	公式	
协方差 (Covariance)	$Cov(R_A, R_B) = \sum_{i,j=1}^n P(R_{A,i}, R_{B,j}) [R_{A,i} - E(R_A)] [R_{B,j} - E(R_B)]$	$Cov(R_A, R_B) \in (-\infty, +\infty)$ 协方差大于0, 表示两个变量有同向变动的趋势; 协方差小于0, 表示两个变量有反向变动的趋势。 $\rho_{i,j} \in [-1, 1]$
相关系数 (Correlation)	$\rho_{i,j} = \frac{Cov(R_i, R_j)}{\sigma_i \sigma_j}, r_{i,j} = \frac{Cov(R_i, R_j)}{s_i s_j}$	$\rho_{i,j} = 1$ , $R_i$ 与 $R_j$ 完全线性正相关 $\rho_{i,j} = -1$ , $R_i$ 与 $R_j$ 完全线性负相关 $\rho_{i,j} = 0$ , $R_i$ 与 $R_j$ 无线性关系

## Reading 9 Common Probability Distributions

### □ 离散分布 (Discrete Distribution)

名称	公式	
二项式分布期望 (Expected Value of Binomial Random Variables)	$E = np$	n: 伯努利试验次数 p: 试验成功的概率
二项式分布方差 (Variance for Binomial Random Variables)	$\sigma^2 = np(1-p)$	n: 伯努利试验次数 p: 试验成功的概率
二项式分布概率公式 (Probability of Binomial Random Variables)	$P(x) = C_n^x p^x (1-p)^{n-x} = \frac{n!}{(n-x)! x!} p^x (1-p)^{n-x}$	n: 伯努利试验次数 p: 试验成功的概率 x: 试验成功的次数

### □ 连续分布 (Continuous Distribution)

名称	公式	
正态分布标准化 (Standardization)	$Z = \frac{X - \mu}{\sigma}$	X: 样本观测值, 符合正态分布 $\mu$ : 正态分布均值 $\sigma$ : 正态分布标准差

## Reading 9 Common Probability Distributions

名称	公式	
安全第一比率 (Safety-first Ratio)	$SFRatio = \frac{E(R_p) - R_L}{\sigma_p}$	$R_L$ : shortfall level $E(R_p)$ : 组合预期收益率 $\sigma_p$ : 组合收益率标准差

## Reading 10 Sampling and Estimation

### □ 置信区间 (Confidence Interval)

名称	公式	
均值置信区间 (Confidence Interval of Population Mean)	$\bar{X} \pm Z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$	总体方差已知
均值置信区间 (Confidence Interval of Population Mean)	$\bar{X} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$	总体方差未知 df=n-1

## Reading 11 Hypothesis Testing

名称	公式	
单个均值检验统计量 (总体方差已知)	$z = \frac{\bar{X} - \mu_0}{\sigma / \sqrt{n}}$	$Z$ : z检验统计量 $\bar{X}$ : 样本均值 $\mu_0$ : 假设总体均值 $\sigma$ : 总体标准差
单个均值检验统计量 (总体方差未知)	$t_{n-1} = \frac{\bar{X} - \mu_0}{s / \sqrt{n}}$	$t_{n-1}$ : t检验统计量 $\bar{X}$ : 样本均值 $\mu_0$ : 假设总体均值 $s$ : 样本标准差
相关系数检验统计量	$t_{n-2} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$	$t_{n-2}$ : t检验统计量 $r$ : 样本相关系数 $n$ : 样本大小



## Reading 12 The Topics in Demand and Supply Analysis

### □ 需求弹性(Elasticity of demand)

价格弹性 The sensitivity of the quantity demanded to a change in price.

收入弹性 The sensitivity of the quantity demanded to a change in income.

交叉价格弹性 The responsiveness of the quantity demanded to a change in price of substitutes or complements.

### □ 计算公式

价格弹性  
(Own-price elasticity of demand)  $E_{P_X}^d = \frac{\% \Delta Q_X^d}{\% \Delta P_X} = \frac{\frac{\Delta Q_X^d}{Q_X^d}}{\frac{\Delta P_X}{P_X}} = \left( \frac{\Delta Q_X^d}{\Delta P_X} \right) \left( \frac{P_X}{Q_X^d} \right)$   $P_X$ : 商品X的价格

交叉弹性  
(Cross-price elasticity of demand)  $E_{P_Y}^d = \frac{\% \Delta Q_X^d}{\% \Delta P_Y} = \frac{\frac{\Delta Q_X^d}{Q_X^d}}{\frac{\Delta P_Y}{P_Y}} = \left( \frac{\Delta Q_X^d}{\Delta P_Y} \right) \left( \frac{P_Y}{Q_X^d} \right)$   $P_Y$ : 商品Y的价格

收入弹性  
(Income elasticity of demand)  $E_I^d = \frac{\% \Delta Q_X^d}{\% \Delta I} = \frac{\frac{\Delta Q_X^d}{Q_X^d}}{\frac{\Delta I}{I}} = \left( \frac{\Delta Q_X^d}{\Delta I} \right) \left( \frac{I}{Q_X^d} \right)$   $I$ : 消费者收入

## Reading 12 The Topics in Demand and Supply Analysis

### □ 收入 (Revenue)

总收入  
(Total revenue, TR)  $TR = P \times Q$

平均收入  
(Average revenue, AR)  $AR = \frac{TR}{Q}$

边际收入  
(Marginal revenue, MR)  $MR = \frac{\Delta TR}{\Delta Q}$   $MR = P \left[ 1 - \frac{1}{|\epsilon_p|} \right]$   $\epsilon_p$ : 需求价格弹性

### □ 成本 (Cost)

总成本  
(Total cost, TC)  $TC = TVC + TFC$

平均固定成本  
(Average fixed cost, AFC)  $AFC = \frac{TFC}{Q}$

平均可变成本  
(Average variable cost, AVC)  $AVC = \frac{TVC}{Q}$

边际成本  
(Marginal cost, MC)  $MC = \frac{\Delta TC}{\Delta Q}$

## Reading 14 Aggregate Output, Prices, and Economic Growth

### □ GDP平减指数(GDP deflator)

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100$$

### □ GDP的核算方法 (GDP calculation)

支出法  
(Expenditure approach)  $GDP = C + I + G + (X - M)$

$C$ : 私人部门消费  
 $I$ : 国内私人部门投资  
 $G$ : 政府部门支出  
 $X - M$ : 净出口

收入法  
(Income approach)  $GDP = C + S + T$

$S$ : 私人部门储蓄  
 $T$ : 政府税收

### □ 货币数量论 (Quantity theory of money)

$$MV = PY$$

$M$ : 名义货币供给  
 $V$ : 货币流通速度  
 $P$ : 平均价格水平  
 $Y$ : 实际收入/支出

## Reading 14 Aggregate Output, Prices, and Economic Growth

### □ 生产函数 (The production function)

$$\begin{array}{l} \text{生产函数} \\ \text{(Production function)} \end{array} Y = Af(L, K) \quad A: \text{技术水平/全要素生产率}$$

### □ 潜在GDP增长率 (Growth in potential GDP)

$$\text{Growth in potential GDP} = \text{Growth in technology} + W_L (\text{Growth in labor}) + W_C (\text{Growth in capital})$$

$$\text{Growth in potential GDP} = \text{Long-term growth rate of labor force} + \text{Long-term labor productivity growth rate}$$

### □ 人均潜在GDP增长率 (Growth in per capita potential GDP)

$$\text{Growth in per capita potential GDP} = \text{Growth in technology} + W_C (\text{Growth in capital-to-labor ratio})$$

## Reading 15 Understanding Business Cycles

### □ 失业率 (Unemployment rate)

$$\text{Unemployment rate} = \text{Unemployed} / (\text{Labor force})$$

### □ 劳动率参与率 (Participation ratio)

$$\text{Participation ratio} = \text{Labor force} / (\text{Working-age population})$$

## Reading 16 Monetary and Fiscal Policy

### □ 货币乘数 (Money multiplier)

$$\text{Money multiplier} = 1 / \text{Reserve requirement}$$

$$\text{Money created} = \text{New deposit} \times \text{Money multiplier} = \text{New deposit} / \text{Reserve requirement}$$

### □ 费雪效应 (Fisher effect)

$$r_{nom} = r_{real} + \text{expected inflation}$$

### □ 财政乘数 (Fiscal multiplier)

$$\begin{array}{l} \text{忽略所得税:} \\ \text{Ignoring income taxes} \end{array} \text{Fiscal multiplier} = 1 / (1 - c) \quad c: \text{边际消费倾向} \\ \text{(Marginal propensity to consume)}$$

$$\begin{array}{l} \text{考虑所得税:} \\ \text{Including income taxes} \end{array} \text{Fiscal multiplier} = 1 / [1 - c(1 - t)] \quad t: \text{净税率(Net tax rate)}$$

## Reading 18 Currency Exchange Rates

### □ 实际汇率(Real exchange rate)

$$Real_{d/f} = Nominal_{d/f} \times \frac{P_f}{P_d}$$

$Real_{d/f}$ : 实际汇率  
 $Nominal_{d/f}$ : 名义汇率  
 $P_f$ : 外国物价水平  
 $P_d$ : 本国物价水平

### □ 利率平价(Interest rate parity)

$$\frac{F_{forward(D/F)}}{S_{spot(D/F)}} = \frac{1 + r_{DC}}{1 + r_{FC}}$$

$F_{forward(D/F)}$ : 远期汇率  
 $S_{spot(D/F)}$ : 即期汇率  
 $r_{DC}$ : 本国无风险利率  
 $r_{FC}$ : 外国无风险利率

# PART 3 Financial Reporting and Analysis

## Reading 19 Financial Statement Analysis: An introduction

### □ 财务报表等式 (Financial Statement Equation)

名称	公式
资产负债表恒等式 (Balance sheet equation)	Assets = Liabilities + Owners' equity
利润表等式 (Income statement equation)	Income - Expenses = Net income
综合收益表等式 (Comprehensive income statement equation)	Comprehensive income = Net income + OCI

## Reading 21 Understanding the I/S

- 每股收益-基本每股收益 (Earnings Per Share – Basic EPS)

$$\text{Basic EPS} = \frac{\text{NI} - \text{Div}_{\text{Preferred stock}}}{\text{Weighted average number of common shares outstanding}}$$

- 每股收益-稀释每股收益 (Earnings Per Share – Diluted EPS)

$$\text{Diluted EPS} = \frac{\text{NI} - \text{Div}_{\text{Preferred stock}} + \Delta \text{分子}}{\text{Weighted average number of common shares outstanding} + \Delta \text{分母}}$$

## Reading 21 Understanding the I/S

- 复杂结构证券-可转换优先股

$$\Delta \text{分子} \quad \text{可转换优先股股数} \times \text{每股股利}$$

$$\Delta \text{分母} \quad \text{可转换优先股股数} \times \text{转换比率}$$

- 复杂结构证券-可转债

$$\Delta \text{分子} \quad \text{可转债税后利息费用}$$

$$\Delta \text{分母} \quad \text{债券张数}(\text{可转债总面值} \div 1,000) \times \text{转换比率}$$

- 复杂结构证券-期权/权证

$$\Delta \text{分子} \quad 0$$

$$\Delta \text{分母} \quad \text{行权认购股份数} - \text{公开市场回购股份数}$$

$$\text{公开市场回购股份数} \quad \text{行权认购股份数} \times \text{执行价格} \div \text{公开市场回购平均价格}$$

## Reading 21 Understanding the I/S

- 每股收益-检验反稀释作用

比较结果

处理原则

$$\text{Basic EPS} \leq \frac{\Delta \text{分子}}{\Delta \text{分母}} \quad \text{反稀释作用, 此时 Diluted EPS} = \text{Basic EPS}$$

$$\text{Basic EPS} > \frac{\Delta \text{分子}}{\Delta \text{分母}} \quad \text{稀释作用, 代入公式计算出 Diluted EPS} < \text{Basic EPS}$$

## Reading 22 Understanding the B/S

### □ 合并商誉 (Consolidated Goodwill)

合并商誉 (Consolidated goodwill)  $\text{Consolidated goodwill} = \text{Purchase price} - \text{Fair value of acquiree's net identifiable assets}$

可辨认净资产公允价值 (Fair value of net identifiable assets)  $\text{Fair value of net identifiable assets} = \text{Fair value of acquiree's identifiable assets} - \text{Fair value of liabilities and contingent liabilities}$

## Reading 23 Understanding the C/F

### □ 经营活动现金流(CFO)-直接法(Direct Method)

CFO Calculation by Direct Method

Cash received from customers  $A/R_{\text{Beg}} + \text{Net sales} - \text{Cash received} = A/R_{\text{End}}$

Cash paid to suppliers  $\text{Inv}_{\text{Beg}} + \text{Purchase} - \text{COGS} = \text{Inv}_{\text{End}}$   
 $A/P_{\text{Beg}} + \text{Purchase} - \text{Cash paid} = A/P_{\text{End}}$

Cash paid to employees  $\text{Wage payable}_{\text{Beg}} + \text{Wage expense} - \text{Cash paid} = \text{Wage payable}_{\text{End}}$

Interest paid  $\text{Interest payable}_{\text{Beg}} + \text{Interest expense} - \text{Cash paid} = \text{Interest payable}_{\text{End}}$

Taxes paid  $\text{Tax payable}_{\text{Beg}} + \text{Tax expense} - \text{Cash paid} = \text{Tax payable}_{\text{End}}$

## Reading 23 Understanding the C/F

### □ 经营活动现金流(CFO)-间接法(Indirect Method)

CFO Calculation by Indirect Method

Start point NI

Step one: Adj. income statement items  $+ \text{Depreciation/Amortization}$   
 $+/- \text{ Non operating items}$

Step two: Adj. balance sheet items  $- \text{Increase/+Decrease in non cash current asset accounts(eg: A/R, Inventory...)}$   
 $- \text{Decrease/+Increase in current liability accounts(eg: A/P, Tax payable...)}$

= CFO

## Reading 23 Understanding the C/F

### □ 投资活动现金流(CFI)-处置长期资产

$$\text{Calculation of BV of disposal } BV_{\text{Beg}} + \text{Purchase} - \text{Depreciation} - BV_{\text{Disposal}} = BV_{\text{End}}$$

$$\text{Calculation of cash proceeds from disposal } \text{Gain/Loss from disposal} = \text{Cash proceeds} - BV_{\text{Disposal}}$$

### □ 自由现金流(FCFF/FCFE)

$$\text{FCFF(1)} \quad \text{FCFF} = \text{NI} + \text{NCC} - \text{WC Inv.} - \text{FC Inv.} + \text{Interest exp.} \times (1 - \text{Tax rate})$$

$$\text{FCFF(2)} \quad \text{FCFF} = \text{CFO} - \text{FC Inv.} + \text{Interest exp.} \times (1 - \text{Tax rate})$$

$$\text{CFO} \approx \text{NI} + \text{NCC} - \text{WC Inv.}$$

$$\text{FCFE(1)} \quad \text{FCFE} = \text{FCFF} - \text{Interest exp.} \times (1 - \text{Tax rate}) + \text{Net debt borrowing}$$

$$\text{FCFE(2)} \quad \text{FCFE} = \text{CFO} - \text{FC Inv.} + \text{Net debt borrowing}$$

## Reading 24 Financial Analysis Techniques

### □ 营运能力比率(Activity Ratios)

$$\text{Turnover Ratios} \quad \text{Number of Days} = 365 / \text{Turnover}$$

$$\text{A/R turnover} = \text{Revenue} / \text{Ave. A/R} \quad \text{Days of sales outstanding(DSO)}$$

$$\text{Inventory turnover} = \text{COGS} / \text{Ave. Inventory} \quad \text{Days of inventory on hand(DOH)}$$

$$\text{A/P turnover} = \text{Purchase} / \text{Ave. A/P} \quad \text{Number of days of payable}$$

$$\text{Total asset turnover} = \text{Revenue} / \text{Ave. Total asset} \quad \text{略}$$

### □ 短期偿债能力比率(Liquidity Ratios)

$$\text{流动比率(Current ratio)} \quad \text{Current assets} / \text{Current liabilities}$$

$$\text{速动比率(Quick ratio)} \quad (\text{Cash} + \text{Marketable securities} + \text{A/R}) / \text{Current liabilities}$$

$$\text{现金比率(Cash ratio)} \quad (\text{Cash} + \text{Marketable securities}) / \text{Current liabilities}$$

$$\text{经营周期(Operating cycle)} \quad \text{DOH} + \text{DSO}$$

$$\text{现金循环周期(Cash conversion cycle)} \quad \text{DOH} + \text{DSO} - \text{Number of days of payable}$$

## Reading 24 Financial Analysis Techniques

### □ 长期偿债能力比率(Solvency Ratios)

$$\text{杠杆(Leverage)} \quad \text{Debt/Equity}, \text{Debt}/(\text{Debt} + \text{Equity}), \text{Debt}/\text{Assets}, \text{Ave. Assets}/\text{Ave. Equity}$$

$$\text{利息保障倍数(Interest coverage)} = \text{EBIT} / \text{Interest}$$

保障倍数(Coverage)

$$\text{固定费用保障倍数(Fixed charge coverage)} \\ = (\text{EBIT} + \text{Lease payment}) / (\text{Interest} + \text{Lease payment})$$

### □ 盈利能力比率(Profitability Ratios)

$$\text{资本回报率} \quad \text{ROA} = \text{NI} / \text{Average total assets}$$

$$\text{(Return on capital)} \quad \text{ROE} = \text{NI} / \text{Average total equity}$$

$$\text{利润率} \quad \text{Gross profit margin} = \text{Gross profit} / \text{Revenue}$$

$$\text{(Profit/Sales)} \quad \text{Operating profit margin} = \text{Operating profit} / \text{Revenue}$$

$$\text{Net profit margin} = \text{Net income} / \text{Revenue}$$

## Reading 24 Financial Analysis Techniques

### □ 杜邦财务分析(DuPont Analysis)

初始比率  $ROE = \frac{NI}{Ave. Equity}$

二分法  $ROE = ROA \left( \frac{NI}{Ave. Assets} \right) \times \text{Financial leverage} \left( \frac{Ave. Assets}{Ave. Equity} \right)$

三分法  $ROE = \text{Net profit margin} \left( \frac{NI}{Revenue} \right) \times \text{Total asset turnover} \left( \frac{Revenue}{Ave. Assets} \right) \times \text{Financial leverage} \left( \frac{Ave. Assets}{Ave. Equity} \right)$

五分法  $ROE = \text{Tax burden} \left( \frac{NI}{EBT} \right) \times \text{Int. burden} \left( \frac{EBT}{EBIT} \right) \times \text{EBIT margin} \left( \frac{EBIT}{Revenue} \right) \times \text{Total asset turnover} \left( \frac{Revenue}{Ave. Assets} \right) \times \text{Financial leverage} \left( \frac{Ave. Assets}{Ave. Equity} \right)$

## Reading 24 Financial Analysis Techniques

### □ 市价比率(Valuation Ratios)

每股经营活动现金流(CFO per share)  $\frac{CFO}{\text{Weighted average number of shares outstanding}}$

每股股利(Dividend per share)/DPS  $\frac{\text{Common dividends declared}}{\text{Weighted average number of shares outstanding}}$

股利支付率(Dividend payout ratio)  $\frac{\text{Common dividends declared}}{\text{Net income attributable to common shares}}$  or  $\frac{DPS}{EPS}$

留存收益率(Retention ratio)  $1 - \text{Dividend payout ratio}$

可持续增长率(Sustainable growth rate)  $ROE \times \text{Retention rate} = ROE \times (1 - \text{Dividend payout ratio})$

## Reading 25 Inventories

### □ 存货减值(Loss Measurement)-IFRS

减值计提(Loss recognized)  $\text{Loss recognized} = \text{BV of inventory} - \text{NRV}$

可变现净值(NRV)  $\text{NRV} = \text{Selling price} - \text{Selling costs}$

### □ 存货减值(Loss Measurement)-US GAAP

减值计提(Loss recognized)  $\text{Loss recognized} = \text{BV of inventory} - \text{Market}$

条件	市场(Market)取值
Replacement cost $\in$ (NRV - Profit, NRV)	Replacement cost
Replacement cost $\leq$ NRV - Profit	NRV-Profit
Replacement cost $\geq$ NRV	NRV

### □ 存货分析(Inventory Analysis)-LIFO Reserve

I/S(From LIFO to FIFO)  $\text{COGS}_{\text{FIFO}} = \text{COGS}_{\text{LIFO}} - \Delta \text{LIFO reserve}$   
 $\Delta \text{LIFO reserve} = \text{LIFO reserve}_{\text{End}} - \text{LIFO reserve}_{\text{Beg}}$

B/S(From LIFO to FIFO)  $\text{Inventory}_{\text{FIFO}} = \text{Inventory}_{\text{LIFO}} + \text{LIFO reserve}$

## Reading 26 Long-Lived Assets

### □ 长期资产折旧(Depreciation)

折旧方法 当期折旧(Depreciation cost/expense)

$$\text{直线折旧法 (Straight line Method)} \quad \text{Depreciation expense} = \frac{\text{Cost} - \text{Residual value}}{\text{Useful life}}$$

$$\text{加速折旧法 (DDB)} \quad \text{Depreciation expense} = \frac{2}{\text{Useful life}} \times (\text{Cost} - \text{Accumulated depreciation})$$

$$\text{产量法 (Units of production Method)} \quad \text{Depreciation expense} = \frac{\text{Cost} - \text{Residual value}}{\text{Total capacity}} \times \text{Actual output in current period}$$

## Reading 26 Long-Lived Assets

### □ 长期资产减值(Impairment)-IFRS

减值计提(Impairment recognized)  $\text{Impairment loss} = \text{BV of assets} - \text{Recoverable amount}$

可收回金额(Recoverable amount) The higher of NRV or Value in use(PV of  $\sum CF_i$ )

可变现净值(NRV)  $\text{NRV} = \text{Fair value of assets} - \text{Selling costs}$

### □ 长期资产减值(Impairment)- US GAAP

减值测试(Impairment test) 有减值:  $\text{BV of assets} > \text{Undiscounted future cash flows generated by assets}$   
 无减值:  $\text{BV of assets} < \text{Undiscounted future cash flows generated by assets}$

减值计提(Impairment recognized)  $\text{Impairment loss} = \text{BV of assets} - \text{Fair value of assets (or PV of } \sum CF_i)$

## Reading 27 Income Taxes

### □ 所得税(Income Taxes)-基本公式

所得税费用(Income tax expense)  $\text{Income tax expense} = \text{Current tax payable} + \Delta \text{DTL} - \Delta \text{DTA}$

应交所得税(Tax payable)  $\text{Current tax payable} = \text{Taxable income} \times \text{Current tax rate}$

递延所得税资产/负债(DTA or DTL)  $\text{Temporary difference} (\text{Accounting base} - \text{Tax base}) \times \text{Future tax rate}$

### □ 所得税(Income Taxes)-税率变更调整

税率调整后新递延所得税资产/负债(DTA or DTL)  $\text{Temporary difference} \left( \frac{\text{Old DTA or DTL}}{\text{Old tax rate}} \right) \times \text{New tax rate}$

税率调整带来的变化( $\Delta \text{DTA}$  or  $\Delta \text{DTL}$ )  $\Delta \text{DTA or } \Delta \text{DTL} = \text{New DTA or DTL} - \text{Old DTA or DTL}$

## Reading 28 Non-current (Long-term) Liabilities

### □ 长期负债(Long-Term Liabilities)-初始确认

$$\text{长期负债初始确认金额(PV)} = \frac{\text{FV} - \text{Par value, PMT} = -\text{Coupon payment, I/Y} = \text{Effective market rate, N}}{= N \rightarrow \text{PV}}$$

### □ 长期负债(Long-Term Liabilities)-后续计量

$$\text{t年末长期负债金额(BV}_t) = \frac{\text{FV} = -\text{Par value, PMT} = -\text{Coupon payment, I/Y} = \text{Effective market rate, N} = N - t \rightarrow \text{PV}_t(\text{BV}_t)}{\text{BV}_{t-1} + \text{Interest expense}_t - \text{Coupon payment} = \text{BV}_t}$$

$$\text{t年利息费用(Interest expense)} = \text{BV}_{t-1} \times \text{Effective market rate}$$

$$\text{t年支付利息(Coupon payment)} = \text{Par value} \times \text{Coupon rate}$$

$$\text{t年债券账面余额摊销(Bond amortization)} = \text{Interest expense} - \text{Coupon payment}$$

### □ 长期负债(Long-Term Liabilities)-终止确认

提前赎回债券/提前还债 提前赎回债券/提前还债损益

$$\text{BV}_t - \text{Cash Paid}$$

$$\text{Cash paid} > \text{BV}_t \rightarrow \text{Loss}$$

$$\text{Cash paid} < \text{BV}_t \rightarrow \text{Gain}$$

## Reading 28 Non-current (Long-term) Liabilities

### □ 承租人(Lessee)

初始确认 A "ROU" asset = A lease liability = PV of fixed lease payments

Balance sheet

The balance of the lease liability is reduced for the portion of the lease payment that represents repayment of the lease liability.

Income statement

后续计量 IFRS and finance lease under US GAAP: Depreciation expense on the "ROU" asset;  
Interest expense on the lease liability  
Operating lease under US GAAP: A single lease expense

### □ 出租人(Lessor)-融资租赁(Finance Lease)

销售型融资租赁(Sales-type lease)

直接融资租赁(Direct financing lease)

	销售型融资租赁(Sales-type lease)	直接融资租赁(Direct financing lease)
初始确认	I/S Selling profit or loss = Revenue - COGS Revenue = Value of leased asset COGS = Carrying value of leased asset	No profit recognized
	B/S Remove leased asset Lease receivable and residual	Remove leased asset Lease receivable
后续计量	I/S	Interest income = Implicit interest rate × Lease receivable <sub>Beg</sub>

## PART 4 Corporate Finance

## Reading 19 Capital Budgeting

### □ 作为投资决策标准的变量

净现值 (Net present value, NPV)	$NPV = \sum_{t=1}^n \frac{CF_t}{(1+r)^t} - Outlay$ $CF_t = \text{after-tax cash flow at time } t$ $r = \text{required rate of return of the project}$ $Outlay = \text{cash investment at time zero}$	Decision criterion: If NPV > 0, then invest If NPV < 0, then do not invest
内部收益率 (Internal rate of return, IRR)	$\sum_{t=0}^n \frac{CF_t}{(1+IRR)^t} = 0$	The discount rate that equates the sum of the present value of cash flows with initial outlay.
投资回收期 (Payback period, PB)	$PB = A + \frac{B}{C}$	A = the last period with negative total cash flow B = the absolute value of cumulative cash flow at the end of the period A C = the cash flow during the period after A
盈利指数 (Profitability index, PI)	$PI = \frac{PV \text{ of future cash flows}}{ CF_0 }$ $= 1 + \frac{NPV}{ CF_0 }$	Decision criterion: If PI > 1, then accept/invest If PI < 1, then reject/not invest

## Reading 20 Cost of capital

### □ 加权平均资本成本 (Weighted average cost of capital, WACC)

$$WACC = w_d \times k_d \times (1-t) + w_{ps} \times k_{ps} + w_{ce} \times k_{ce}$$

$w_d, w_{ps}, w_{ce}$  = the proportion of debt, preferred shares, and common stocks that the company uses, respectively  
 $k_d, k_{ps}, k_{ce}$  = the before-tax marginal cost of debt, preferred shares, and common stocks, respectively  
 $t$  = the company's marginal tax rate

### □ 债务成本 (Cost of debt) : 到期收益率 (Yield to maturity, YTM)

$$P_0 = \frac{PMT}{(1+YTM)^1} + \frac{PMT}{(1+YTM)^2} + \dots + \frac{PMT}{(1+YTM)^n} + \frac{FV}{(1+YTM)^n}$$

$P_0$  = the current market price of the bond  
 $PMT$  = each period's coupon payments  
 $YTM$  = the annual rate that an investor earns on a bond if the investor purchases the bond today and holds it until maturity  
 $n$  = the number of periods remaining to maturity

## Reading 33 Cost of capital

### □ 优先股成本 (Cost of preferred stock)

$$k_{ps} = \frac{D_{ps}}{P}$$

$k_{ps}$  = the cost of preferred stock  
 $D_{ps}$  = the preferred stock dividend per share  
 $P$  = the current preferred stock price per share

### □ 普通股成本 (Cost of common equity, or cost of equity)

资本资产定价模型  
 (Capital asset pricing model,  
 CAPM)

$$k_{ce} = R_f + \beta_i [E(R_m) - R_f]$$

$k_{ce}$  = the cost of common equity  
 $\beta_i$  = the return sensitivity of stock I to changes in the market return  
 $R_f$  = risk-free rate  
 $E(R_m)$  = the expected return on the market  
 $E(R_m) - R_f$  = the expected market risk premium

## Reading 33 Cost of capital

### □ 普通股成本 (Cost of common equity, or cost of equity)

股利贴现模型  
(Dividend discount model, DDM)

$$(1) r_e = \frac{D_1}{P_0} + g;$$

$$(2) g = ROE \times b$$

$g$  = the growth rate of annual dividend  
 $b$  = retention rate = 1 - dividend payout ratio, 留存收益率.  
 $D_1 = D_0 \times (1 + g)$ , the expected dividends next period.

### □ 普通股成本 (Cost of common equity, or simply called cost of equity)

债券收益率加风险溢价  
(Bond yield plus risk premium)

$$k_{ce} = k_d + \text{Risk premium}$$

**Risk premium:** 风险溢价, 该溢价补偿了投资者因持有股票而承担的高于债券风险的额外风险

### □ 与资本成本估计相关的其他概念和公式

贝塔估算  
(Estimating and determining  $\beta$ )

$$\beta_{asset} = \beta_{equity} \frac{1}{1 + (1 - t) \frac{D}{E}}$$

$$\beta_{equity} = \beta_{asset} \left[ 1 + (1 - t') \frac{D'}{E'} \right]$$

$\beta_{asset}$  = the unleveraged beta  
 $\beta_{equity}$  = the leveraged beta  
 $t, D, E$  refer to public company's data.  
 $t', D', E'$  refer to non-public company's data.

## Reading 34 Measures of leverage

### □ 经营杠杆水平 (Degree of operating leverage, DOL)

基本形式:

$$DOL = \frac{\% \text{ change in operating income (EBIT)}}{\% \text{ change in units sold}} = \frac{\Delta EBIT / EBIT}{\Delta Q / Q}$$

其中:

$$EBIT = \text{Operating income} = \frac{(P - V)Q - F}{\text{Contribution margin}}$$

$P$  = unit price of a product  
 $V$  = unit variable cost of a product  
 $Q$  = quantity of a product  
 $F$  = fixed costs of production, irrelevant to quantity produced

对DOL基本形式作变形:  $DOL = \frac{Q(P - V)}{Q(P - V) - F}$

## Reading 34 Measures of leverage

### □ 财务杠杆水平 (Degree of financial leverage, DFL)

基本形式:

$$DFL = \frac{\% \text{ change in net income}}{\% \text{ change in EBIT}} = \frac{\Delta NI / NI}{\Delta EBIT / EBIT} = \frac{EBIT}{EBIT - Int}$$

对DFL基本形式作变形:

$$DFL = \frac{[Q(P - V) - F]}{[Q(P - V) - F - Int]}$$

$Int$  = fixed financial costs (interest expense)

### □ 总杠杆水平 (Degree of total leverage, DTL)

基本形式:

$$DTL = \frac{\% \text{ change in net income}}{\% \text{ change in number of units sold}} = \frac{\Delta NI / NI}{\Delta Sales / Sales}$$

DTL is the product of DOL and DFL.

对DTL基本形式作变形:

$$DTL = DOL \times DFL = \frac{Q(P - V)}{Q(P - V) - F - Int}$$

## Reading 34 Measures of leverage

### □ 经营盈亏平衡点 (Operating breakeven point, $Q_{OBE}$ )

$$Q_{OBE} = \frac{\text{Fixed Operating Costs}}{\text{Unit Contribution Margin}} = \frac{F}{P - V}$$

$P$  = unit price of a product  
 $V$  = unit variable cost of a product  
 $Q$  = quantity of a product  
 $F$  = fixed costs of production, irrelevant to quantity produced

### □ 盈亏平衡点 (Breakeven point, $Q_{BE}$ )

$$Q_{BE} = \frac{\text{Fixed Costs}}{\text{Unit Contribution Margin}} = \frac{F + \text{Int}}{P - V}$$

$P$  = unit price of a product  
 $V$  = unit variable cost of a product  
 $Q$  = quantity of a product  
 $F$  = fixed costs of production, irrelevant to quantity produced  
 $\text{Int}$  = fixed financial costs (interest expense)

## Reading 35 Working capital management

### □ 流动性测量指标汇总

流动比率 (Current ratio)	$\frac{\text{Current assets}}{\text{Current liabilities}}$	
速动比率 (Quick ratio)	$\frac{\text{Cash} + \text{Short-term securities} + \text{Receivables}}{\text{Current liabilities}}$	
应收账款周转率 (Accounts receivable (AR) turnover)	$\frac{\text{Credit sales}}{\text{Average AR}}$	Number of days in receivables = $\frac{365}{\text{AR turnover}}$
存货周转率 (Inventory turnover)	$\frac{\text{Costs of goods sold (COGS)}}{\text{Average inventory}}$	Number of days of inventory = $\frac{365}{\text{Inventory turnover}}$
应付账款周转率 (Accounts payable (AP) turnover)	$\frac{\text{Purchases}}{\text{Average AP}}$	Number of days of payables = $\frac{365}{\text{AP turnover}}$
经营净周期 (Net operating cycle)	$\text{Number of days in receivables} + \text{Number of days of inventory} - \text{Number of days of payables}$	

## Reading 35 Working capital management

### □ 短期投资品种收益率 (Yield) 公式汇总

货币市场收益率 (Money market yield)	$\left(\frac{FV - P}{P}\right) \times \left(\frac{360}{M}\right)$	
债券等价收益率 (Bond equivalent yield, BEY)	$\left(\frac{FV - P}{P}\right) \times \left(\frac{365}{M}\right)$	$FV$ = face value $P$ = purchase price $M$ = number of days to maturity
贴现基准收益率 (Discount-basis yield)	$\left(\frac{FV - P}{FV}\right) \times \left(\frac{360}{M}\right)$	

### □ 短期借款成本 (Costs of borrowing)

$$\text{借款成本 (Costs of borrowing)} = \frac{\text{Interest} + \text{Dealer's commission} + \text{Backup costs}}{\text{Loan amount} - \text{Interest}}$$

### □ 应付账款管理 (Management of accounts payable)

$$\text{贸易信贷成本 (Costs of trade credit)} = \left(1 + \frac{\% \text{discount}}{1 - \% \text{discount}}\right)^{\frac{365}{\text{days past discount}}} - 1$$

# PART 5 Equity Investment

## Reading 36 Market Organization and Structure

### □ 杠杆头寸(Leveraged Position)

名称	公式
杠杆比率 (Leverage Ratio)	$\text{Leverage Ratio} = \frac{\text{Value of the Position}}{\text{Value of Equity Investment}}$
追加保证金价格 (Margin Call Price)	$P_c = P_0 \frac{1 - IM}{1 - MM}$

$P_c$ : 追加保证金价格  
 $P_0$ : 期初价格  
 $IM$ : 初始保证金比例  
 $MM$ : 维持保证金比例

## Reading 37 Security Market Indexes

### □ 指数回报(Index Return)

名称	公式
价格回报 (Price Return)	$PR_1 = \frac{V_1 - V_0}{V_0}$
总回报 (Total Return)	$TR_1 = \frac{V_1 - V_0 + Inc_1}{V_0}$

$PR_1$ : 价格回报  
 $V_1$ : 期末价格指数值  
 $V_0$ : 期初价格指数值  
 $TR_1$ : 总回报  
 $V_1$ : 期末价格指数  
 $V_0$ : 期初价格指数  
 $Inc_1$ : 期间证券总收益

### □ 价格加权指数 (Price Weighting Index)

名称	公式
价格加权指数	$\text{Index} = \frac{\sum_{i=1}^N P_i}{N}$
价格加权指数 (证券拆分/合股情况)	$\text{Index} = \frac{\sum_{i=1}^N P_i}{\text{Divisor}}$

$P_i$ : 第*i*证券价格  
 $N$ : 期初证券数量  
 Divisor: 调整因子

## Reading 37 Security Market Indexes

### □ 等权重加权指数(Equal Weighting Index)

名称	公式	
等权重价格回报指数	$Index_1 = Index_0 \left( 1 + \frac{\sum_{i=1}^N PR_i}{N} \right)$	PR <sub>i</sub> : 第i证券的价格回报 Index <sub>1</sub> : 期末价格指数 Index <sub>0</sub> : 期初价格指数
等权重总回报指数	$Index_1 = Index_0 \left( 1 + \frac{\sum_{i=1}^N TR_i}{N} \right)$	TR <sub>i</sub> : 总回报 Index <sub>1</sub> : 期末价格指数 Index <sub>0</sub> : 期初价格指数

### □ 市值加权指数 (Market-Capitalization Weighting Index)

名称	公式	
市值加权价格回报指数	$Index_1 = Index_0 \frac{\sum_{i=1}^N N_i \times P1_i}{\sum_{i=1}^N N_i \times P0_i}$	P1 <sub>i</sub> : 第i证券期末价格 P0 <sub>i</sub> : 第i证券期初价格 N <sub>i</sub> : 第i证券数量
市值加权总回报指数	$Index_1 = Index_0 \frac{\sum_{i=1}^N (N_i \times P1_i + Di)}{\sum_{i=1}^N N_i \times P0_i}$	D <sub>i</sub> : 第i证券期间收益 (例如: 股利)

## Reading 41 Equity Valuation: Concepts and Basic Tools

### □ 股利折现模型(Dividend Discount Model, DDM)

名称	公式	
一期股利折现模型 (One-Period DDM)	$V_0 = \frac{D_1}{(1+r)} + \frac{P_1}{(1+r)}$	V <sub>0</sub> : 股票0时刻现值 D <sub>1</sub> : 第1期期末股利 P <sub>1</sub> : 股票第1期期末价格 r: 折现率
N期股利折现模型 (N-Period DDM)	$V_0 = \sum_{i=1}^N \frac{D_i}{(1+r)^i} + \frac{P_N}{(1+r)^N}$	D <sub>i</sub> : 第i期期末股利 P <sub>N</sub> : 第N期期末价格(终值价格)
戈登增长模型 (GGM)	$V_0 = \frac{D_1}{(r-g)} = \frac{D_0(1+g)}{(r-g)}$	g: 股利固定增长率 D <sub>0</sub> : 股票在0时刻派发的股利
两阶段股利折现模型 (Two-Stage DDM)	$V_0 = \sum_{i=1}^N \frac{D_0(1+g_h)^i}{(1+r)^i} + \frac{P_N}{(1+r)^N}$ $P_N = \frac{D_{N+1}}{r-g_l}$	g <sub>h</sub> : 第1阶段高速股利增长率 g <sub>l</sub> : 第2阶段低速股利增长率 D <sub>N+1</sub> : 第N+1期期末股利
优先股股利折现模型	$V_0 = \frac{D}{r}$	D: 优先股股利

## Reading 41 Equity Valuation: Concepts and Basic Tools

### □ 现金流折现模型(Free Cash Flow Discount Model)

名称	公式	
权益自由现金流模型 (FCFE)	$V_0 = \sum_{i=1}^N \frac{FCFE_i}{(1+r)^i}$	FCFE <sub>i</sub> : 第i期权益自由现金流

### □ 乘数模型 (Multiplier Models)

名称	公式	
预期市盈率 (Leading P/E)	$\frac{P}{E} = \frac{\text{Price Per Share}}{\text{Forecast EPS Next 12 Months}}$	
实际市盈率 (Trailing P/E)	$\frac{P}{E} = \frac{\text{Price Per Share}}{\text{EPS Previous 12 Months}}$	
合理预期市盈率 (Justified Leading P/E)	$\frac{P}{E} = \frac{D_1/E_1}{r-g}$	E <sub>1</sub> : 第1期每股收益 D <sub>1</sub> /E <sub>1</sub> : 股利支付率
市净率 (P/B)	$\frac{P}{B} = \frac{\text{Price Per Share}}{\text{Book Value Per Share}}$	
市销率 (P/S)	$\frac{P}{S} = \frac{\text{Price Per Share}}{\text{Sales Per Share}}$	

## Reading 41 Equity Valuation: Concepts and Basic Tools

### □ 乘数模型(Multiplier Models)

名称	公式	
市现率 (P/CF)	$\frac{P}{CF} = \frac{\text{Price Per Share}}{\text{Cash Flow Per Share}}$	
企业价值 (Enterprise Value)	$EV = \text{MV of common stock} + \text{MV of preferred stock} + \text{MV of debt} - \text{cash and investments}$	MV: 市场价值
企业价值乘数 (EV Multiple)	$EV \text{ Multiple} = \frac{\text{Enterprise Value}}{EBITDA}$	EBITDA: 息税折旧摊销前利润

### □ 基于资产的估值模型 (Asset-Based Models)

名称	公式
基于资产的估值模型	$\text{Market value of equity} = \text{Market value of assets} - \text{Market value of liabilities}$

# PART 6 Fixed Income

## Reading 42 Fixed-Income Securities

### □ 票息(Coupon)

票息 (Coupon)	公式
	$\text{Coupon} = \text{Coupon Rate} \times \text{Par Value}$

### □ 浮动票息债券(Floating-rate Notes)

浮动利率债券票息率 (Floating Rate Note)	公式
	$\text{Coupon Rate} = \text{Reference Rate} + \text{Quoted Margin}$

反向浮动票据票息率 (Reverse FRN)	公式
	$\text{Coupon Rate} = \text{Maximum Coupon Rate} - \text{Leverage} \times \text{Reference Rate}$

### □ 内嵌期权(Embedded Option)

可赎回债券 (Callable Bond)	公式
	$V_{\text{Callable Bond}} = V_{\text{Non-callable Bond}} - V_{\text{Call Option}}$

可回售债券 (Puttable Bond)	公式
	$V_{\text{Puttable Bond}} = V_{\text{Non-puttable Bond}} + V_{\text{Put Option}}$

可转换债券 (Convertible Bond)	公式
	$V_{\text{Convertible Bond}} = V_{\text{Straight Bond}} + V_{\text{Call Option on Equity}}$

## Reading 44 Introduction to Fixed-Income Valuation

### □ 市场折现率(Market Discount Rate, r)

$$P = \sum_{t=1}^n \frac{PMT_t}{(1+r)^t} + \frac{F}{(1+r)^n}$$

F: 债券票面价值  
r: 市场折现率

### □ 到期收益率(Yield-to-Maturity, YTM)

$$P = \sum_{t=1}^n \frac{PMT_t}{(1+YTM)^t} + \frac{F}{(1+YTM)^n}$$

F: 债券票面价值  
YTM: 到期收益率

### □ 即期利率(Spot Rates, Zero Rates)

$$P = \sum_{t=1}^n \frac{PMT_t}{(1+Z_t)^t} + \frac{F}{(1+Z_n)^n}$$

F: 债券票面价值  
Z<sub>t</sub>: 在t时间点, 点对应现金流所使用的折现率(即期利率)

### □ 隐含远期利率(Implied Forward Rate)

$$(1+Z_A)^A \times (1+IFR_{A,B-A})^{B-A} = (1+Z_B)^B$$

IFR<sub>A,B-A</sub>: 以A时刻起点, 以(B-A)为期限的远期利率  
Z<sub>A</sub>: 期限为A的即期利率  
Z<sub>B</sub>: 期限为B的即期利率

## Reading 44 Introduction to Fixed-Income Valuation

### □ 平价利率(Par Rate)

$$Par = \sum_{t=1}^n \frac{PMT}{(1+Z_t)^t} + \frac{Par}{(1+Z_n)^n}$$

Par: 债券票面价值  
PMT: 每期支付的票息

$$Par\ Rate = \frac{PMT}{Par}$$

### □ 债券报价和计算(Price Quotation and Calculation)

$$Full\ Price = Flat\ Price + Accrued\ Interest\ (AI)$$

Flat/Clean Price: 债券净价

$$Dirty\ Price = Clean\ Price + Accrued\ Interest\ (AI)$$

$$Full\ Price = \left[ \frac{PMT}{(1+r)^1} + \frac{PMT}{(1+r)^2} + \dots + \frac{PMT+F}{(1+r)^n} \right] \times (1+r)^{t/T}$$

t: 上一付息日至交割日之间的天数  
T: 两个付息日之间的天数

$$AI = \frac{t}{T} \times PMT$$

应计利息 (Accrued Interest, AI)

## Reading 44 Introduction to Fixed-Income Valuation

### □ 当期收益率与简单收益率(Current Yield & Simple Yield)

$$Current\ Yield = \frac{Annual\ Coupon\ payment}{Flat\ Price}$$

$$Simple\ Yield = \frac{(Annual\ Coupon\ Payment + Straight-Line\ Amortization\ of\ Discount\ or\ Premium)}{Flat\ Price}$$

### □ 不同复利频率的年利率(Annual Percentage Rate)之间相互转换

$$\left(1 + \frac{APR_m}{m}\right)^m = \left(1 + \frac{APR_n}{n}\right)^n$$

APR: 年利率  
m, n: 一年复利次数

### □ 货币市场工具(Money Market Instrument)

$$PV = FV \times \left(1 - \frac{Days}{Year} \times DR\right)$$

折扣率 (Discount Rate, DR) DR: 折扣率

$$PV = \frac{FV}{\left(1 + \frac{Days}{Year} \times AOR\right)}$$

附加利率 (Add-on Rate, AOR) AOR: 附加利率

## Reading 44 Introduction to Fixed-Income Valuation

### □ 收益率利差(Yield Spread)

零波动利差 (Zero Volatility Spread, Z-Spread)	$PV = \sum_{t=1}^n \frac{PMT}{(1+Z_t+Z)^t} + \frac{FV}{(1+Z_n+Z)^n}$	$Z_n$ : 政府债券各期即期利率 Z: 恒定的Z-Spread
期权调整利差 (Option-adjusted Spread, OAS)	OAS = Z-spread - Option Value (%) Callable bond: OAS < Z-spread; Puttable bond: OAS > Z-spread	

## Reading 46 Fixed-Income Risk and Return

### □ 收益率久期(Yield Duration)

麦考利久期 (Macaulay Duration)	$MacDur = \frac{\sum_{t=1}^n t \times PVCF_t}{\sum PVCF_t}$	$PVCF_t$ : t时刻现金流的现值 $\sum PVCF_t$ : 所有折现现金流之和
修正久期 (Modified Duration)	$ModDur = \frac{MacDur}{1+r}$ $\% \Delta Price \approx -ModDur \times \Delta Yield$	r: 期间收益率 $\Delta Yield$ : 收益率变动程度
近似修正久期 (Approximate Modified Duration)	$ApproxModDur = \frac{P_- - P_+}{2 \times (\Delta Yield) \times P_0}$ $ApproxMacDur = ApproxModDur \times (1+r)$	$P_-$ : 收益率减少一定程度导致债券价格上升后的债券价格 $P_+$ : 收益率增加同等程度导致债券价格下降后的债券价格 r: 期间收益率
现金久期/美元久期 (Money Duration/Dollar Duration)	$MoneyDur = ModDur \times Price(Full)$ $\Delta P^{Full} \approx -MoneyDur \times \Delta Yield$	Price(Full): 债券全价 $\Delta Yield$ : 收益率变动程度

## Reading 46 Fixed-Income Risk and Return

### □ 基点价值(Price Value of a Basis Point)

基点价值 (PVBP)	$PVBP = \frac{P_- - P_+}{2}$	$P_-$ : 收益率下降一个基点时的债券价格 $P_+$ : 收益率上升一个基点时的债券价格
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### □ 收益率曲线久期(Curve Duration)

有效久期 (Effective Duration)	$EffDur = \frac{P_- - P_+}{2 \times (\Delta Curve) \times P_0}$	$\Delta Curve$ : 收益率曲线变化的幅度 $P_-$ : 收益率曲线向下平移一定幅度导致债券价格上升后的债券价格 $P_+$ : 收益率曲线向上平移同等程度导致债券价格下降后的债券价格 $P_0$ : 收益率曲线变化前的债券价格
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### □ 投资组合久期(Portfolio Duration)

投资组合久期 (Portfolio Duration)	$Portfolio\ Duration = w_1 D_1 + w_2 D_2 + \dots + w_i D_i$	$w_1$ : 债券1的权重 $D_i$ : 债券i的久期
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## Reading 46 Fixed-Income Risk and Return

### □ 凸度(Convexity)

$$\begin{array}{l} \text{凸度} \\ \text{(Convexity)} \end{array} \quad \% \Delta Price^{Full} \approx [-ModDur \times \Delta Yield] + \left[ \frac{1}{2} \times Con \times \Delta Yield^2 \right]$$

$$\begin{array}{l} \text{近似凸度} \\ \text{(Approximate Convexity)} \end{array} \quad ApproxCon = \frac{P_- + P_+ - 2P_0}{(\Delta Yield)^2 \times P_0}$$

$$\begin{array}{l} \text{现金凸度} \\ \text{(Money Convexity)} \end{array} \quad \begin{array}{l} MoneyCon = Convexity \times Price^{Full} \\ \Delta P^{Full} \approx [-MoneyDur \times (\Delta Yield)] + \left[ \frac{1}{2} \times MoneyCon \times (\Delta Yield)^2 \right] \end{array}$$

$$\begin{array}{l} \text{有效凸度} \\ \text{(Effective Convexity)} \end{array} \quad EffecCon = \frac{P_- + P_+ - 2P_0}{(\Delta Curve)^2 \times P_0}$$

### □ 久期缺口(Duration Gap)

$$\begin{array}{l} \text{久期缺口} \\ \text{(Duration Gap)} \end{array} \quad Duration\ Gap = Macaulay\ Duration - Investment\ Horizon$$

## Reading 47 Fundamentals of Credit Analysis

### □ 预期损失率(Expected Loss)

$$\begin{array}{l} \text{预期损失率} \\ \text{(Expected Loss)} \end{array} \quad Expected\ Loss = Default\ Probability \times Loss\ Severity$$

### □ 违约后可回收率(Recovery Rate)

$$\begin{array}{l} \text{违约后可回收率} \\ \text{(Recovery Rate)} \end{array} \quad Recovery\ Rate = 1 - Loss\ Severity$$

### □ 利差(Yield Spread)

$$\begin{array}{l} \text{利差} \\ \text{(Yield Spread)} \end{array} \quad Yield\ Spread = Credit\ Spread + Liquidity\ Premium$$



## PART 7 Derivatives

## Reading 48 Derivative Markets & Instruments

### □ 远期合约(Forward)

远期合约多头损益  
(Payoff of the Long)  $\text{Payoff of the Long (合约到期时)} = S_T - F_0(T)$   $F_0(T)$ : 期初确定的T时刻远期合约价格

远期合约空头损益  
(Payoff of the Short)  $\text{Payoff of the Short(合约到期时)} = F_0(T) - S_T$   $S_T$ : T时刻的现货价格

### □ 看涨期权(Call Option)

购买看涨期权损益  
(Payoff from Buying Call Option)  $C_T = \text{Max}(0, S_T - X)$

购买看涨期权利润  
(Profit from Buying Call Option)  $\Pi = \text{Max}(0, S_T - X) - C_0$

出售看涨期权损益  
(Payoff from Selling Call Option)  $-C_T = -\text{Max}(0, S_T - X)$

出售看涨期权利润  
(Profit from Selling Call Option)  $\Pi = -\text{Max}(0, S_T - X) + C_0$

## Reading 48 Derivative Markets & Instruments

### □ 看跌期权(Put Option)

购买看跌期权损益  
(Payoff from Buying Put Option)  $P_T = \text{Max}(0, X - S_T)$

购买看跌期权利润  
(Profit from Buying Put Option)  $\Pi = \text{Max}(0, X - S_T) - P_0$

出售看跌期权损益  
(Payoff from Selling Put Option)  $-P_T = -\text{Max}(0, X - S_T)$

出售看跌期权利润  
(Profit from Selling Put Option)  $\Pi = -\text{Max}(0, X - S_T) + P_0$

## Reading 49 Basics of Derivative Pricing and Valuation

### □ 现金流量现值(Present Value of Discounted Cash Flow)

现金流量现值  
(Present Value of Discounted Cash Flow)  $S_0 = \frac{E(S_T)}{(1+r+\lambda)^T} - \theta + \gamma$

$E(S_T)$ : 资产在T时刻的期望价值

$r$ : 无风险利率

$\lambda$ : 风险溢价

$\theta$ : 持有该资产需要付出成本的现值

$\gamma$ : 持有该资产可以获得收益的现值

### □ 远期合约定价与估值(Pricing and Valuation of Forward)

签订时价值  
(Value at Initiation)  $V_0(T) = 0$

签订时约定远期价格  
(The Forward Price at Initiation)  $F_0(T) = (S_0 - \gamma + \theta)(1+r)^T$   $\gamma - \theta$ : 净持有成本

存续期价值  
(Value During the Life)  $V_t(T) = S_t - (\gamma - \theta)(1+r)^t - F_0(T)(1+r)^{-(T-t)}$   $T$ : 合约到期时间  
 $T - t$ : 在t时期时合约剩余到期时间

到期价值  
(Value at Expiration)  $V_T(T) = S_T - F_0(T)$

## Reading 49 Basics of Derivative Pricing and Valuation

### □ 期权价值构成(Value of Option Premium)

$$\text{期权价值 (Value of Option Premium)} \quad \text{Option Premium} = \text{Intrinsic Value} + \text{Time Value}$$

### □ 期权平价公式(Put-Call Parity)

$$\text{期权平价公式 (Put-Call Parity)} \quad C + \frac{X}{(1+R_f)^T} = S + P$$

C:看涨期权的价格  
P:看跌期权的价格  
S:股票的价格  
X:行权价(同时也是零息债券的面值)

### □ 期权平价公式的应用(Synthetic Position)

$$\text{合成看涨期权 (Synthetic Call)} \quad C = S + P - \frac{X}{(1+R_f)^T}$$

$$\text{合成看跌期权 (Synthetic Put)} \quad P = C + \frac{X}{(1+R_f)^T} - S$$

$$\text{合成标的股票 (Synthetic Stock)} \quad S = C + \frac{X}{(1+R_f)^T} - P$$

$$\text{合成无风险资产 (Synthetic Bond)} \quad \frac{X}{(1+R_f)^T} = P + S - C$$

C:看涨期权的价格  
P:看跌期权的价格  
S:股票的价格  
X:行权价(同时也是零息债券的面值)  
+:多头头寸  
-:空头头寸

## Reading 49 Basics of Derivative Pricing and Valuation

### □ 远期—期权平价公式(Put-Call-Forward Parity)

$$\text{远期-期权平价公式 (Put-Call-Forward Parity)} \quad C + \frac{X}{(1+R_f)^T} = \frac{F_0(T)}{(1+R_f)^T} + P$$

$$P - C = \frac{X - F_0(T)}{(1+R_f)^T}$$

C:看涨期权的价格  
P:看跌期权的价格  
S:股票的价格  
X:行权价(同时也是零息债券的面值)  
 $F_0(T)$ :标的股票的远期合约价

### □ 一期二叉树模型(One-Period Binomial Model)

$$\text{下跌因子(D)} \quad D = \frac{1}{U} \quad \text{U:上涨因子}$$

$$\text{上涨的风险中性概率}(\pi_U) \quad \pi_U = \frac{1 + R_f - D}{U - D}$$

$$\text{下跌的风险中性概率}(\pi_D) \quad \pi_D = 1 - \pi_U$$

# PART 8 Alternative Investment

## Reading 50 Introduction to Alternative Investments

### □ 大宗商品 (Commodities)

名称	公式
期货价格 (Futures Price)	$\text{Futures Price} \approx \text{Spot Price} (1 + R_f) + \text{Storage Costs} - \text{Convenience Yield}$
期货溢价 (Contango)	$\text{Futures Price} > \text{Spot price}$
现货溢价 (Backwardation)	$\text{Futures Price} < \text{Spot price}$

# PART 9 Portfolio Management

## Reading 52 Portfolio Risk and Return: Part I

### □ 收益率的衡量 (Measurements of Return)

持有期收益率 (Holding Period Return)	$R = \frac{P_T + D_T}{P_0} - 1$	$P_0$ : 资产期初价格 $P_T$ : 资产期末价格 $D_T$ : 股息 (或者其他收入)
算数平均收益率 (Arithmetic Return)	$R = \frac{R_1 + R_2 + R_3 + \dots + R_n}{n}$	$R_1, R_2, \dots, R_n$ : 每期持有期收益率 $n$ : 投资期数
时间加权平均收益率 (Time-weighted return, TWR)	$\text{TWR} = [(1 + \text{HPR}_1) \times \dots \times (1 + \text{HPR}_n)]^{\frac{1}{N}} - 1$	$\text{HPR}_1, \dots, \text{HPR}_n$ : 每期持有期收益率 $N$ : 年数
货币加权收益率 (Money-weighted Return, MWR)	$CF_0 + \frac{CF_1}{(1 + \text{MWR})^1} + \dots + \frac{CF_n}{(1 + \text{MWR})^n} = 0$	$CF_1, \dots, CF_n$ : 每期的现金流

### □ 效用理论 (Utility Theory)

效用函数 (Utility Function)	$U = E(R) - \frac{1}{2} A \sigma^2$	$E(R)$ : 资产的预期收益率 $U$ : 投资者的效用 $A$ : 风险厌恶系数 $\sigma$ : 资产收益率的标准差
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## Reading 52 Portfolio Risk and Return: Part I

### □ 两个风险资产组合的收益 (Return of portfolio with two risky assets)

$$R_p = \omega_1 R_1 + (1 - \omega_1) R_2$$

$\omega_1$ : 资产1的权重  
 $R_1$ : 资产1的收益率  
 $R_2$ : 资产2的收益率

### □ 两个风险资产组合的风险 (Risk of portfolio with two risky assets)

$$\sigma_p = \sqrt{\omega_1^2 \sigma_1^2 + \omega_2^2 \sigma_2^2 + 2\omega_1 \omega_2 \text{cov}(R_1, R_2)}$$

$$= \sqrt{\omega_1^2 \sigma_1^2 + \omega_2^2 \sigma_2^2 + 2\omega_1 \omega_2 \sigma_1 \sigma_2 \rho_{1,2}}$$

总体  $\text{cov}(x, y) = \frac{\sum_{i=1}^N (x_i - E(x))(y_i - E(y))}{N}$ ,  $\rho_{x,y} = \frac{\text{cov}(x, y)}{\sigma_x \sigma_y}$ ;

$\text{cov}(R_1, R_2)$ : 资产1和2收益率的协方差  
 $\rho_{1,2}$ : 资产1和2收益率的总体相关系数  
 $r_{x,y}$ : 资产1和2收益率的样本相关系数

样本  $\text{cov}(x, y) = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{n - 1}$ ,  $r_{x,y} = \frac{\text{cov}(x, y)}{s_x s_y}$ .

## Reading 52 Portfolio Risk and Return: Part I

### □ 无风险资产和单个风险资产组合的收益 (Return of portfolio with risk-free asset and one risky asset)

$$R_p = \omega_{risky} R_{risky} + \omega_{risk-free} R_{risk-free}$$

$\omega_{risky}$ : 风险资产的权重  
 $R_{risky}$ : 风险资产的收益率  
 $R_{risk-free}$ : 无风险资产的收益率

### □ 无风险资产和单个风险资产组合的风险 (Risk of portfolio with risk-free asset and one risky asset)

$$\sigma_p = \omega_{risky} \sigma_{risky}$$

$\sigma_{risky}$ : 风险资产收益率的标准差

### □ 资本配置线 (Capital Allocation Line, CAL)

$$E(R_p) = R_{risk-free} + \frac{E(R_{risky}) - R_{risk-free}}{\sigma_{risky}} \sigma_p$$

$\sigma_p$ : 资产组合收益率的标准差

## Reading 53 Portfolio Risk and Return: Part II

### □ 资本市场线 (Capital Market Line, CML)

$$E(R_p) = R_f + \frac{E(R_m) - R_f}{\sigma_m} \sigma_p$$

$R_f$ : 无风险收益率  
 $E(R_m)$ : 市场的预期收益率  
 $\sigma_m$ : 市场收益率的标准差

### □ 贝塔值 (Beta, $\beta$ )

$$\beta_i = \frac{\text{cov}(R_i, R_m)}{\sigma_m^2} = \frac{\rho_{i,m} \sigma_i \sigma_m}{\sigma_m^2} = \rho_{i,m} \frac{\sigma_i}{\sigma_m}$$

$$\beta_m = \frac{\text{cov}(R_m, R_m)}{\sigma_m^2} = \frac{\sigma_m^2}{\sigma_m^2} = 1$$

$$\beta_{portfolio} = \sum_{i=1}^n \omega_i \beta_i$$

$\rho_{i,m}$ :  $R_i$ 和 $R_m$ 的相关系数  
 $\beta_m$ : 市场的贝塔值  
 $\beta_{portfolio}$ : 投资组合的贝塔值  
 $\omega_i$ : 资产 $i$ 的市值占组合市值的比率, 且  
 $\sum_{i=1}^n \omega_i = 1$

## Reading 53 Portfolio Risk and Return: Part II

### □ 多因子模型(Multi-factor Model)

$$E(R_i) - R_f = \beta_{i,1}E(\text{Factor 1}) + \beta_{i,2}E(\text{Factor 2}) + \dots + \beta_{i,k}E(\text{Factor } k)$$

$\beta_{i,k}$ : 资产  $i$  的超额收益率相对于某个因子  $k$  的敏感性

### □ 单因子模型(Single-index Model)

$$E(R_i) - R_f = \beta_i[E(R_m) - R_f]$$

$E(R_m)$ : 市场的预期收益率

### □ 市场模型(Market Model)

$$R_i = \alpha_i + \beta_i R_m + e_i$$

$\alpha_i$ : 截距项  
 $e_i$ : 残差项

### □ 资本资产定价模型(Capital Asset Pricing Model)

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

$\beta_i$ : 资产  $i$  的系统性风险

## Reading 53 Portfolio Risk and Return: Part II

### □ 夏普比率(Sharpe Ratio)

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

$SR_p$ : 投资组合的夏普比率、CAL的斜率  
 $\sigma_p$ : 投资组合的总风险  
 $R_p$ : 投资组合的总回报

### □ M-Squared( $M^2$ )

$$M^2 = (R_p - R_f) \frac{\sigma_m}{\sigma_p} - (R_m - R_f) = (SR_p - SR_m) \sigma_m$$

$SR_m$ : 市场组合的夏普比率

### □ 特雷诺指数(Treynor Ratio)

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

$\beta_p$ : 投资组合的系统性风险

### □ 詹森指数, $\alpha$ (Jensen's Alpha)

$$\alpha_p = R_p - [R_f + \beta_p(R_m - R_f)]$$