國立屏東科技大學
National PingTung University of Science & Technology

越南碩士在職專班授課
出國報告書

報告人: 葉 憲 弘

出國地點: 越南河內

出國期間: 101 年 12 月 14 日至 101 年 12 月 17 日

國立屏東科技大學企業管理系

中　　華　　民　　國　　102　　年　　01　　月　　25　　日

目　　錄

壹. 目的

依據本校開辦越南境外專班原定計劃書，主要目的在促進國際學術合作，提升多元文化交流，除可提供越南太原大學學生企業管理領域方面的學習外，對本校、本系亦助益良多。首先，對本校、本系的預期效益有：

(1) 增加學校招生機會：穩定的境外專班招生能增加學生總人數，多元招生管道能在少子化的衝擊中開闢新契機。
(2) 營造國際化校園環境氣氛：外籍生來校就讀期間能提供更多在校師生接觸與學習外國文化之機會。
(3) 拓展學校知名度：藉由境外專班海外教學，學校的辦學名聲將有機會直接傳播至友好地區或國家。
(4) 提供師生多元文化學習環境：藉由境外專班的開設，可提供本國師生到他國交換教師或學生之學習機會。
(5) 提供本國師生到他國交換教師或學生的學習機會：將學校的資源及專業知識分享到境外學校，強化學術外交。

其次，對太原大學的預期效益有：

(1) 交流台灣技職教育經驗：結合海外台商產業資源，建立技職教育跨國訓練課程，培訓專業管理人力，深耕技職教育交流深度，擴大國與國技職教育體系之接觸。
(2) 吸取台灣高科技發展、教育輸出、中小企業成長之成功經驗。
(3) 促進與東南亞國家教育體系的合作及交流。
(4) 專業實務之整合與運用：促進產業與學術交流，強化各項專業管理實務之整合及運用能力，進而改善產業體質，提昇競爭力。
(5) 提供越南在職生進修機會，增進其企業管理相關知能，並提昇其學術研究能力。
(6) 提供當地華人或台商進修及學習高階管理理論之機會，以提升華人或台商經營企業之知識及技能。

本人此行出差至越南河內太原大學國際學院，是為了支援此境外在職碩士專班之「公司理財專題」授課，該專班是本校第一個境外碩士專班。藉由支援碩士專班英語授課，有助於增加本校教師國際化「全英語授課」教學經驗與能力。

貳．過程

一、出國期間行程

1. 在 101 年 12 月 14 日週五早上從高雄搭乘高鐵至桃園高鐵站，轉搭接駁車至桃園國際機場，搭乘越南航空班機直飛至越南河內，並於當地時間下午三點半左右抵達。
2. 12 月 15 日與 12 月 16 日兩天有十四小時授課。
3. 回國前，12 月 17 日早上與太原大學國際學院院長 Dr. Anh 與其行政人員等五人，針對本專班相關問題交換意見，也交由本人帶回相關文件轉交國際事務處處長陳和賢教授。並於 12 月 17 日週一下午搭乘班機直飛回國至高雄，可以順利接續隔日國內授課。

二、授課主題綱要（授課投影片請參見附件）

1. An Overview of Financial Management 財務管理概論
   a) The role of finance 財務功能之角色
   b) Different types of jobs in finance 不同類型的財務工作機會
   c) Different forms of business organization 不同形態的商業組織
   d) Corporate management's goal：Shareholder wealth maximization 公司經營目標：股東財富極大化
   e) The importance of business ethics 企業倫理的重要性
   f) Potential conflicts Arising from Agency Problem 代理問題引起的潛在衝突

2. Financial Statements, Cash Flow and Taxes
   a) Financial statements and reports 財務報表與報導
   b) Balance sheet 資產負債表
   c) Income statement 損益表
   d) Statement of cash flows 現金流量表
   e) Statement of stockholders' equity 股東權益表
   f) Free cash flow 自由現金流量
   g) Tax effect 課稅效果

3. Discounted Cash Flow Valuation 折現現金流量評價
   a) Future values 未來值 and Present values 現值
   b) Finding the interest rate, *i* 計算出利率
   c) Finding the number of years, N 計算出期別數
   d) Ordinary annuity and Annuity Due 普通年金與到期年金

e) Perpetuities 永續年金
f) Uneven cash flows 不均等現金流量
g) Loan amortization 貸款攤還

4. Bonds and Their Valuation 債券與其評價
a) Key Features of Bonds 債券主要特性
b) Bond Valuation 債券評價
c) Measuring Bond Yield 衡量債券收益
d) Assessing Bond Risk 衡量債券風險

三、授課情形

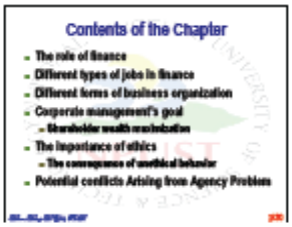
1. 第一次對越南學生上課，授課老師與學生雙方都需要適應與調整，因此在進度上有稍為落後一些，但不會有太大影響。
2. 教學即教與學需要教師與學生雙方能有良好的溝通，才能有優異的教學成果。授課老師與越南學生雙方需要適當的溝通，以利雙方相互的瞭解，破除文化差異的隔閡，進而提升就學成效。

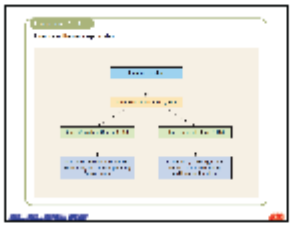
參. 心得與建議

1. 一般而言，與亞洲學生類似，在課堂學習上越南學生較內向、謙恭有禮，學習態度佳。該國經濟尚屬低度發展或開發中國家之型態，國民所得水準較低，但未來高等教育之需求，將會隨其經濟發展成長而持續成長。
2. 境外專班之開設，增加本校師生與對方學校師生之間相互了解，有助於雙方進一步的學術交流與研究合作。
3. 國內高等教育正值國際化轉型之際，境外專班的招生開設可以提高本校在越南教育產業之知名度，亦可藉機吸引更多當地國學生來本校進修。

肆. 附件(授課投影片)

附件一：An Overview of Financial Management　(共 4 頁)





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Corporation

- Advantages
  - Unlimited life
  - Easy transfer of ownership (股份容易轉讓)
  - Limited liability
  - Easy to raise large amount of capital
- Disadvantages
  - Costs of set-up and report filing
  - Double taxation

Special Forms of Business Organization in the U.S.

- S Corporation (small business corporation)
- Limited Liability Partnership (LLP)
- Limited Liability Company (LLC)

Special Forms of Business Organization in the U.S.

S corporation in the USA

- A relatively small, privately owned firm
- Subsection S of the Tax Code
- Number of Stockholders ≤ 75
- No double taxation

Special Forms of Business Organization in the U.S.

Limited Liability Company (LLC)

- A hybrid between a partnership and a corporation
- It is used by non-professional firms.
- It is like corporations but is taxed like partnerships.

Special Forms of Business Organization in the U.S.

Limited Liability Partnership (LLP)

- A hybrid between a partnership and a corporation
- It is used by professional firms in the fields of
  - Accounting, law and architecture
- It is like corporations but is taxed like partnerships.

Share prices and Shareholder Wealth

- Shareholder wealth maximization
  - Management's primary goal
- Residual value of a firm
  = Total Assets – Total Debts
  - Available to be distributed to shareholders.
- Share (or stock) price maximization
  - The way to maximize shareholders' wealth

Intrinsic Values, Share Prices, and Compensation Plans

- The value of an asset
  - The sum of the present value of future cash flows
- The intrinsic value of a firm's share
  - Managerial actions
  - Economic environment
  - Political climate or environment

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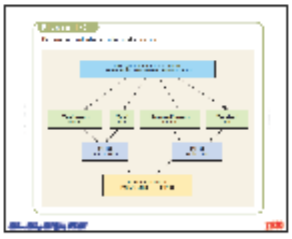
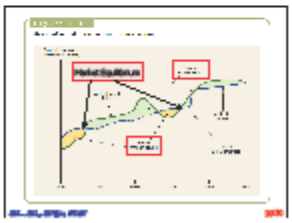


Intrinsic Values, Share Prices, and Compensation Plans

- Intrinsic value = Market price ➔ Market equilibrium (市場均衡)
- Intrinsic value > Market price ➔ stock is undervalued or underpriced.
- Intrinsic value < Market price ➔ stock is overvalued or overpriced.



Some Important Business Trends

- More accuracy of published statements
  - To prohibit providing inaccurate information to shareholders and investors (Sarbanes-Oxley Act)
- Increased globalization of business
  - Development in communication technology for the use of real-time data on business operation
- Profound effect of information technology (IT)
  - Improvements in IT are spurring globalization.
- Corporate governance
  - The way the top managers operate and interface with shareholders

Business Ethics 企業倫理

- Definition of Ethics in Webster's dictionary
  - Standards of conduct or moral behavior
- Can be thought of as a company's attitude and conduct toward its employees, customers, community, and shareholders.
- New York Attorney General Elliot Spitzer and others sued companies for improper acts.
- Congress has passed legislation imposing sanctions on executives who do bad things.

continued ...

Business Ethics 企業倫理

- A firm's commitment to business ethics can be measured by the tendency of its employees, from the top down, to adhere to laws, regulations, and moral standards relating to:
  - Product safety and quality,
  - fair employment, marketing and selling practices,
  - the use of confidential information for personal gain,
  - community involvement, and
  - Illegal payments to obtain business.

What Companies Are Doing

- Strong written codes of ethical behavior
- Training programs to ensure that employees understand proper behavior
- When conflicts arise involving profits and ethics, ethical considerations sometimes are so obviously important that they dominate.
- In some cases, however, the right choices are not clear.

Consequences of Unethical Behavior

- Unethical behavior can lead to a firm's decline.
  - Enron in USA
  - Pcode (博達) in Taiwan
- These frauds (詐欺) also contributed to fatal wounds to shareholders, other firms and even whole industries.
  - Arthur Anderson accounting firm audited Enron.
- Unethical actions can have consequences far beyond the firms that commit them.

How should employees deal with unethical behavior?

- What would you do if you were the CEO or high ranking mangers of Enron or Pcode (博達) ?
- If an employee goes ahead and sounds an alarm or reports the situation to a higher authority, he or she might be in trouble regardless of the merits of the case.
  - Disloyal and troublemaking employee?
- This places employees in a dilemma (進退兩難).

Business Ethics Issues in Indonesia and Vietnam

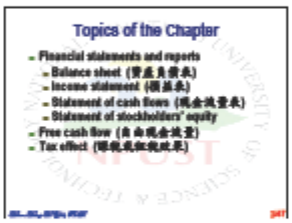
- Unethical Behavior in Indonesia ?
- Unethical Behavior in Vietnam ?

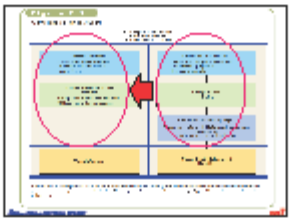

Conflicts between Managers, Stockholders, and Creditors
An agency relationship exists whenever a principal hires an agent to act on their behalf.
Within a corporation, agency relationships exist between:
Shareholders and managers
Shareholders and creditors

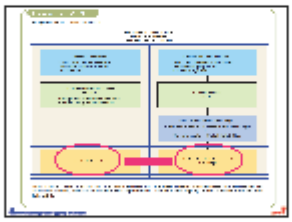

Conflicts Between Managers and Shareholders
Managers are naturally inclined to act in their own best interests.
The following factors or actions affect managerial behavior:
Managerial compensation plans
Direct intervention by shareholders
The threat of firing and takeovers

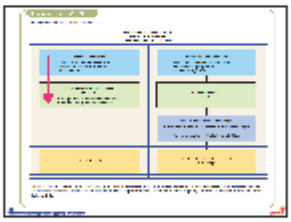

Shareholders versus Creditors
Shareholders (through managers) could take actions to maximize share price that are damaging to creditors.
In the long run, such actions will raise the cost of debt and ultimately lower stock price.

附件二：Financial Statements, Cash Flows and Taxes　(共 6 頁)









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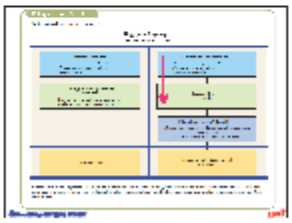
Balance Sheets 資產負債表

- Assets at the left side
  - Ordered by the sequence of liquidity, i.e. the ability of an asset to be converted into cash at market price quickly without any discount
- Liabilities and equity at the right side
  - Claims against firm's assets
  - Liabilities are ordered in the time sequence in which they must be paid.



Balance Sheets 資產負債表
Current Assets

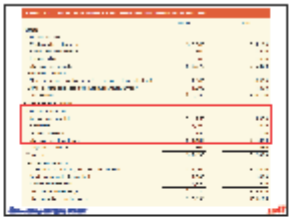
- Cash and cash equivalent,
- Marketable securities
- Accounts receivable (AR) and
- Inventory
- Prepaid expenses and
- Other current assets

Balance Sheets 資產負債表
Fixed Assets

- Tangible assets
  - Buildings
  - Real estate
  - Equipment and furniture
- Depreciation
  - A deduction from the original value of FAs
  - No cash flow effect
- Intangible assets
  - Do not physically exist.
  - Intellectual properties (IP): franchise, trademarks, goodwill, patents and copyrights

Balance Sheets 資產負債表
Current Liabilities

- Current liabilities are short-term obligations that must be paid in one year.
- Current liabilities include:
  - Short-term loans
  - Trade credits
  - Dividends and interest payable
  - Consumer deposits
  - Unpaid taxed and
  - Long-term debt that are due within one year



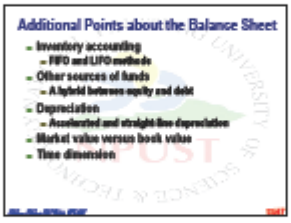
Balance Sheets 資產負債表
Long-term Liabilities

- Long-term liabilities are obligations that must be paid in more than a year.
- Long-term liabilities include long-term debts and long-term accrued liabilities.
- Long-term liabilities management concerns the issue of capital structure in finance.
  - Capital structure is one of the most important topics in corporate finance.

2

Balance Sheets 資產負債表
Owners' Equity

- Owners' equity represents a firm's net worth.
- The difference between the value of all assets and the value of all liabilities.
- Residual value
  - Contributed capital
  - Retained earnings



Additional Points about the Balance Sheet

- Inventory accounting
  - FIFO and LIFO methods
- Other sources of funds
  - A hybrid between equity and debt
- Depreciation
  - Accelerated and straight-line depreciation
- Market value versus book value
- Time dimension

Income Statement 損益表

- Summarizing the operation performance over a reporting period
- Operating income (i.e. EBIT)
  - Earnings from operations before interest and taxes
- Earnings before Taxes (EBT)
- The Bottom line (i.e. Earnings per share, EPS)
  - Dividend per share (DPS)
  - Book value per share (BVPS)
- EBITDA: Earnings from operations before interest, taxes, depreciation and amortization

Statement of Cash Flows 現金流量表

- OPERATING ACTIVITIES 營運活動
  - Net Income
  - Adjustments:
    - non-cash charges (+)
    - Non-cash revenues (−)
  - Changes in working capital other than cash
    - Increase in non-cash CA (−)
    - Increase in CL (+)

  continued...

Statement of Cash Flows 現金流量表

- INVESTING ACTIVITIES 投資活動
  - Increase in FA (−)
  - Decrease in FA (+)
- FINANCING ACTIVITIES 融資活動
  - Increase (decrease) in Debt (+)
  - Dividend payment (−)

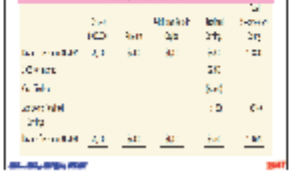
3

Statement of Cash Flows: Summary

The statement of cash flows is used to help answer such questions:

- Is the firm generating enough cash to purchase the additional assets required for growth?
- Is the firm generating any extra cash that can be used to repay debt or to invest in new products?

Statement of Stockholders' Equity
股東權益表



Statement of Stockholders' Equity
股東權益表

- Retained earnings represent a claim against assets, not assets per se. 保留盈餘與公司資產有著關聯，但並非資產。
- Retained earnings reported on the balance sheet does not represent cash available for dividend payments or anything else. 保留盈餘本身並非現金，無法做為股利發放與其他資金用途之運用。

Free Cash Flow 自由現金流量

- FCF: the amount of cash that could be withdrawn from a firm without harming its ability to operate and to produce future CFs
  - = (Operating cash flow) × (1 – Tax rate) – (Net Invt.)
  - = EBIT×(1 – Tax rate) + Depreciation – (Gross Invt.)
  - = EBIT × (1 – Tax rate) + Depreciation – [(Capital expenditure) + (Increase in WC)]
  - = EBIT (1 – Tax rate) + Depreciation – (ΔFA+ΔCA – ΔNon-interest-bearing CL)

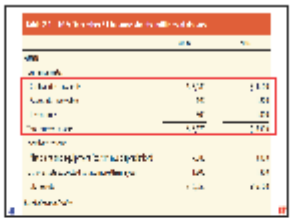
Example: Calculating Free Cash Flow

- FCF for TGE, 2008 = ?

Example: Calculating Free Cash Flow

FCF for TGE, 2008

- = EBIT (1 – Tax rate) + Depreciation – (Gross investment)
- = EBIT × (1 – Tax rate) + Depreciation – [(Capital expenditure) + (Increase in WC)]
- = EBIT (1 – Tax rate) + Depreciation – (ΔFA+ΔCA – ΔNon-interest-bearing CL)



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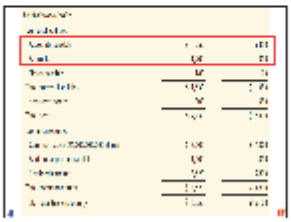


Example: Calculating Free Cash Flow

FCF for TGE, 2008

= EBIT (1 – Tax rate) + Depreciation – (Gross Investment)

= EBIT (1 – Tax rate) + Depreciation – (ΔFA+ΔCA – Δnon-interest-bearing CL)

= $4,800 (1 – 0.4) + $2,400 – [($2,600 + ($,570 – 6,300) – (1,450 – 1,350)]

= $3,130

Income Taxes

Individual income taxes 個人綜合所得稅

- Progressive tax system 累進稅制
  - High income ⇒ high tax
- Regressive tax system 累退稅制
  - High income ⇒ low tax
- Proportional tax system 比例稅制
  - High-income and low-income taxpayers pay the same fraction of income.
- Marginal tax rate vs. Average tax rate

Income Tax Rate, Taiwan

Taxable Income	Rate
$0 – $410,000	6%
$410,000 – $1,090,000	13%
$1,090,000 – $2,180,000	21%
$2,180,000 – $4,090,000	30%
$4,090,000 and above	40%

If taxable income = $800,000, then

Income Tax= ?

Income Tax Rate, Taiwan

Taxable Income	Rate
$0 – $410,000	6%
$410,000 – $1,090,000	13%
$1,090,000 – $2,180,000	21%
$2,180,000 – $4,090,000	30%
$4,090,000 and above	40%

If taxable income = $800,000, then

Income Tax= $410,000×6% +$390,000×13%

= $24,600+$50,700 = $75,300

Income Tax Rate, Taiwan

Taxable Income	Rate
$0 – $410,000	6%
$410,000 – $1,090,000	13%
$1,090,000 – $2,180,000	21%
$2,180,000 – $4,090,000	30%
$4,090,000 and above	40%

If taxable income = $800,000, then

Average tax rate = $75,300/$800,000

= 9.41%

Income Taxes

Individual income taxes 個人綜合所得稅

- Progressive tax system 累進稅制
- Marginal tax rate vs. Average tax rate
- Capital gain or loss 資本利得或損失
- Alternative minimum tax (AMT)
  - Created by the US Congress in 1969 because 155 millionaires paid no taxes.

continued ...

Income Taxes

Corporate taxes (USA)

- Interest and dividends received by a corporation
  - Interest income received is taxed as ordinary income at the ordinary tax rate.
  - 70% of dividends received is excluded from taxable income.
- Interest and dividends paid by a corporation
  - Interest income paid can be deducted from operating income to obtain taxable income.
  - However, dividends paid cannot be deducted.

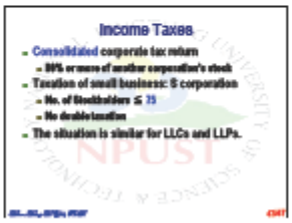
Income Taxes

Tax Effect 稅後成本

- After-Tax income
  - = Before-Tax income × (1 – T)
- Inter-corporate dividend exclusion
  - To avoid triple taxation (70% in the US)

5


Income Taxes
- Corporate capital gains 資本利得稅
- Taxed at lower rates before 1987 but now taxed at the same rates as operating income.
- Corporate loss carry-back
- Carried back to each of the preceding 2 years and used to offset taxable income in those years
- Corporate loss carry-forward
- Carried forward for the next 20 years and used to offset taxable income in those years


Income Taxes
- Consolidated corporate tax return
- 80% or more of another corporation's stock
- Taxation of small business: S corporation
- No. of Stockholders ≤ 75
- No double taxation
- The situation is similar for LLCs and LLPs.

附件三：Discounted Cash Flow Valuation （共 11 頁）

國立屏東科技大學
National PingTung University of Science & Technology

Special Topics on Corporate Finance

Discounted Cash Flow Valuation (Time Value of Money)

[redacted]

Topics of the chapter

- Future values 未來值 and Present values 現值
  - Finding the interest rate, *i*
  - Finding the number of years, N
- Annuities 年金
  - Ordinary annuity 普通年金 & annuity due 到期年金
- Perpetuities 永續年金
- Uneven cash flows 不均等現金流量
- Semiannual and other compounding
- Comparing interest rates
- Loan amortization 貸款攤還

2/88

Time Lines

- Each cash flow occurs at both the end of one period and the beginning of the next one.

3/88

Types of Cash Flows

- A lump-sum cash flow 單一整筆現金流量
- Even cash flows 均等現金流量
  - Ordinary annuity 普通年金
  - Annuity due 到期年金
- Uneven cash flows 不均等現金流量

4/88

Future Value and Compounding

- Compounding 複利計息
  - The process of going from present values to future values
- Compound interest 複利
  - Interest can be earned on prior period's interest

$FV_n = PV(1+i)^n$

- Simple interest 單利

$FV_n = PV(1+n \times i)$

5/88

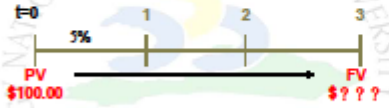
Approaches to solve time value problems 計算時間價值的方法

- Step-by-step approach 按部就班法
- Formula approach 公式法
- Financial calculator 財務計算機
  - *hp* calculator
  - Texas Instruments calculator
- Spreadsheets 試算表

6/88

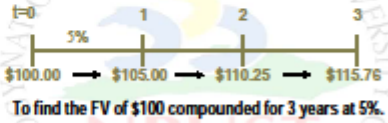
1

To find the FV of $100 compounded for 3 years at 5%



7/88

Step-by-step Approach



To find the FV of $100 compounded for 3 years at 5%.

- $100.00(1+5%)=$105.00
- $105.00(1+5%)=$110.25
- $110.25(1+5%)=$115.76

8/88

Formula Approach

$FV_n = PV(1+i)^n = \$100.00(1+5\%)^3$
$= \$115.76$

9/88

Spreadsheets Approach: *Excel* Spreadsheet Software

- Formula = FV (rate, n, pmt, PV)

=FV(0.05,3,0,-100)
"-100" denotes $100 paid.
$115.76

10/88

Present Value and Discounting

- $PV = FV_n / (1+i)^n$
  - Opportunity cost (i)
- Discounting
  - the reverse of compounding

11/88

Finding the interest rate, i

- $FV_n = PV(1+i)^n$
- $\$150=\$100(1+i)^{10}$
- $1.5=(1+i)^{10}$
- $i = 4.14\%$

12/88

2

Finding the number of years, N

- $FV_n = PV(1+i)^n$
- $\$1{,}000{,}000 = \$500{,}000(1+4.5\%)^N$
- $N = 15.7473 \fallingdotseq 16$ years

13/88

The Rule of 70

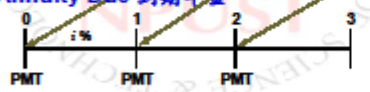
- To become double with i (%) in about N years ($N \fallingdotseq 70 / i$)
- Example:
  - \$500,000 deposit with 4.5% interest rate
  - $N \fallingdotseq 70 / 4.5 = 16$ years

14/88

Annuities

Ordinary Annuity 普通年金

Annuity Due 到期年金



15/88

Future value of an ordinary annuity

$FVA_{ordinary,n} = \Sigma PMT(1+i)^n$
$= PMT(1+i\%)^2 + PMT(1+i\%)^1 + PMT(1+i\%)^0$

16/88

Example: Future Value of an Ordinary Annuity

N	3		
i	5%	PMT =	$100.00
n	Payment(n)	FVIF	FV
1	100.00	[redacted]	
2	100.00		
3	100.00		

17/88

Example: Future Value of an Ordinary Annuity

N	3		
i	5%	PMT =	$100.00
n	Payment(n)	FVIF	FV
1	100.00	110.25%	$ 110.25
2	100.00	105.00%	$ 105.00
3	100.00	100.00%	$ 100.00
			$ 315.25

18/88

Future value of an annuity due

$FVA_{due,n} = \Sigma PMT(1+i)^n$

$= PMT(1+i\%)^3 + PMT(1+i\%)^2 + PMT(1+i\%)^1$

Thus, given an amount of PMT,

$FVA_{due} = FVA_{ordinary}(1+i)$.

19/88

Example: Future Value of an annuity due

N	3		
i	5%	PMT =	$100.00

N	Payment(N)	FVIF	FV
1	100.00	115.76%	$ 115.76
2	100.00	110.25%	$ 110.25
3	100.00	105.00%	$ 105.00
	315.25	1.05	$ 331.01

20/88

Present value of an ordinary annuity

$PVA_{ordinary,n} = \Sigma PMT(1+i)^{-n}$

$= PMT(1+i\%)^{-1} + PMT(1+i\%)^{-2} + PMT(1+i\%)^{-3}$

$$= PMT\left[\frac{1-(1+i)^{-n}}{i}\right]$$

21/88

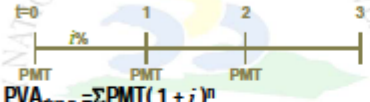
Example: Present value of an ordinary annuity

N	3		
i	5%	PMT =	$100.00

N	Payment	PVIF	PV
1	100.00	95.24%	$ 95.24
2	100.00	90.70%	$ 90.70
3	100.00	86.38%	$ 86.38
			$ 272.32

22/88

Present value of an annuity due



$PVA_{due,n} = \Sigma PMT(1+i)^n$

$= PMT(1+i\%)^0 + PMT(1+i\%)^{-1} + PMT(1+i\%)^{-2}$

$= [PMT(1+i\%)^{-1} + PMT(1+i\%)^{-2} + PMT(1+i\%)^{-3}](1+i)$

$$= PMT\left[\frac{1-(1+i)^{-n}}{i}\right](1+i)$$

23/88

Example: Present value of an annuity due

N	3		
i	5%	PMT =	$100.00

N	Payment	PVIF	PV
1	100.00	100.00%	$ 100.00
2	100.00	95.24%	$ 95.24
3	100.00	90.70%	$ 90.70
	272.32	1.05	$ 285.94

24/88

Finding annuity payments, periods, and interest rates

- Finding annuity payments, PMT
- Finding periods, N
- Finding interest rates, *i*

25/88

Finding annuity payments, PMT

We need to accumulate $10,000 and have it available 5 years from now. (*i*=6%)

- Ordinary annuity
- Annuity due

26/88

Finding annuity payments, PMT (Ordinary Annuity)

$FV_{ordinary,n} = \Sigma PMT(1+i)^n$

$\$10{,}000 = PMT(1+6\%)^4 + PMT(1+6\%)^3 + PMT(1+6\%)^2 + PMT(1+6\%)^1 + PMT(1+6\%)^0$

PMT = $???

27/88

Finding annuity payments, PMT (Ordinary Annuity)

N	5	future value	$ 10,000.00
i	6%	PMT =	$1,773.9640
N	Payment	FVIF	FV
1	1,773.9640	126%	$ 2,239.5887
2	1,773.9640	119%	$ 2,112.8195
3	1,773.9640	112%	$ 1,993.2260
4	1,773.9640	106%	$ 1,880.4018
5	1,773.9640	100%	$ 1,773.9640
			$ 10,000.0000

28/88

Finding annuity payments, PMT

We need to accumulate $315.25 and have it available 3 years from now. (*i*=5%)

- Ordinary annuity
- Annuity due

29/88

Finding annuity payments, PMT (Ordinary Annuity)

$FV_{ordinary,n} = \Sigma PMT(1+i)^n$

$\$315.25 = PMT(1+5\%)^2 + PMT(1+5\%)^1 + PMT(1+5\%)^0$

PMT = $???

30/88

Example: Finding annuity payments Ordinary Annuity

N	3		
i	5%	PMT =	$100.00
n	Payment(n)	FVIF	FV
1	100.00	110.25%	$ 110.25
2	100.00	105.00%	$ 105.00
3	100.00	100.00%	$ 100.00
			$ 315.25

31/88

Example: Finding annuity payments Annuity Due

N	3		
i	5%	PMT =	$100.00
n	Payment(n)	FVIF	FV
1	100.00	115.76%	$ 115.76
2	100.00	110.25%	$ 110.25
3	100.00	105.00%	$ 105.00
			$ 331.01

32/88

Example: Finding annuity payments Ordinary Annuity

N	3		
i	5%	PMT =	$98.23
n	Payment(n)	FVIF	FV
1	98.23	115.76%	$ 113.71
2	98.23	110.25%	$ 108.30
3	98.23	105.00%	$ 103.14
			$ 325.15

33/88

Finding annuity payments, PMT (Annuity Due)

$FV_{ordinary,n} = \Sigma PMT(1+i)^n$

$\$10{,}000 = PMT(1+6\%)^5 + PMT(1+6\%)^4 + PMT(1+6\%)^3 + PMT(1+6\%)^2 + PMT(1+6\%)^1$

PMT = $???

34/88

Finding annuity payments, PMT (Annuity Due)

N	5	future value	$ 10,000.00
i	6%	PMT =	$1,673.5509
N	Payment	FVIF	FV
1	1,673.5509	134%	$ 2,239.589
2	1,673.5509	126%	$ 2,112.819
3	1,673.5509	119%	$ 1,993.226
4	1,673.5509	112%	$ 1,880.402
5	1,673.5509	106%	$ 1,773.964
			$ 10,000.000

35/88

Finding Periods, N: Ordinary Annuity

N	5	future value	$ 6,764.5116
i	6%	PMT =	$1,200
N	Payment	FVIF	FV
1	1,200.0000	126%	$ 1,514.9724
2	1,200.0000	119%	$ 1,429.2192
3	1,200.0000	112%	$ 1,348.3200
4	1,200.0000	106%	$ 1,272.0000
5	1,200.0000	100%	$ 1,200.0000
			$ 6,764.5116

36/88

6

Finding Periods, N : Ordinary Annuity

N	6	future value	$ 8,370.3822
i	6%	PMT =	$1,200
N	Payment	FVIF	FV
1	1,200.0000	134%	$ 1,605.8707
2	1,200.0000	126%	$ 1,514.9724
3	1,200.0000	119%	$ 1,429.2192
4	1,200.0000	112%	$ 1,348.3200
5	1,200.0000	106%	$ 1,272.0000
6	1,200.0000	100%	$ 1,200.0000
			$ 8,370.3822

37/88

Finding Periods, N : Ordinary Annuity

N	7	future value	$ 10,072.6052
i	6%	PMT =	$1,200
N	Payment	FVIF	FV
1	1,200.0000	142%	$ 1,702.2229
2	1,200.0000	134%	$ 1,605.8707
3	1,200.0000	126%	$ 1,514.9724
4	1,200.0000	119%	$ 1,429.2192
5	1,200.0000	112%	$ 1,348.3200
6	1,200.0000	106%	$ 1,272.0000
7	1,200.0000	100%	$ 1,200.0000
			$ 10,072.6052

38/88

Finding Periods, N : Annuity Due

N	6	future value	$ 8,872.6052
i	6%	PMT =	$1,200
N	Payment	FVIF	FV
1	1,200.0000	142%	$ 1,702.2229
2	1,200.0000	134%	$ 1,605.8707
3	1,200.0000	126%	$ 1,514.9724
4	1,200.0000	119%	$ 1,429.2192
5	1,200.0000	112%	$ 1,348.3200
6	1,200.0000	106%	$ 1,272.0000
			$ 8,872.6052

39/88

Finding Periods, N : Annuity Due

N	7	future value	$ 10,676.9615
i	6%	PMT =	$1,200
N	Payment	FVIF	FV
1	1,200.0000	150%	$ 1,804.3563
2	1,200.0000	142%	$ 1,702.2229
3	1,200.0000	134%	$ 1,605.8707
4	1,200.0000	126%	$ 1,514.9724
5	1,200.0000	119%	$ 1,429.2192
6	1,200.0000	112%	$ 1,348.3200
7	1,200.0000	106%	$ 1,272.0000
			$ 10,676.9615

40/88

Finding interest rates, *i*
Ordinary Annuity

N	5	Future Value	$ 10,000.0000
i	25.783945%	PMT =	$1,200
N	Payment	FVIF	FV
1	1,200.0000	250%	$ 3,003.8766
2	1,200.0000	199%	$ 2,388.1240
3	1,200.0000	158%	$ 1,898.5921
4	1,200.0000	126%	$ 1,509.4073
5	1,200.0000	100%	$ 1,200.0000
			$ 10,000.0000

41/88

Perpetuities (永續年金)

- Perpetuity: a stream of equal payments at fixed intervals expected to continue forever
- PV of a perpetuity = PMT / *i*
- Consol
  - A perpetual bond issued by the British government to consolidate past debts
  - In general, any perpetual bond is called consol.

42/88

The Consol's Value

Face Value =$1,000; Coupon rate=2.5%

- *i*=2.5% in 1888
  Consol value$_{1888}$=$1,000*2.5%/2.5%
  =$1,000
- *i*=5.2% in 2004

43/88

The Consol's Value

Face Value =$1,000; Coupon rate=2.5%

- *i*=2.5% in 1888
  Consol value$_{1888}$=$1,000*2.5%/2.5%
  =$1,000
- *i*=5.2% in 2004
  Consol value$_{2004}$=$1,000*2.5%/5.2%
  =$480.77
- *i*=2% now

44/88

The Consol's Value

Face Value =$1,000; Coupon rate=2.5%

- *i*=2.5% in 1888
  Consol value$_{1888}$=$1,000*2.5%/2.5%
  =$1,000
- *i*=5.2% in 2004
  Consol value$_{2004}$=$1,000*2.5%/5.2%
  =$480.77
- *i*=2% now
  Consol value=$1,000*2.5%/2%
  =$1,250.00

45/88

N	5	Face value	$ 1,000
i	10%	Payment =	$ 100.00
N	Payment	PVIF	PV
1	100.00	90.91%	$ 90.91
2	100.00	82.64%	$ 82.64
3	100.00	75.13%	$ 75.13
4	100.00	68.30%	$ 68.30
5	100.00	62.09%	$ 62.09
6	100.00	56.45%	$ 56.45
7	100.00	51.32%	$ 51.32
8	100.00	46.65%	$ 46.65
9	100.00	42.41%	$ 42.41
10	100.00	38.55%	$ 38.55
11	100.00	35.05%	$ 35.05
12	100.00	31.86%	$ 31.86
13	100.00	28.97%	$ 28.97
14	100.00	26.33%	$ 26.33
15	100.00	23.94%	$ 23.94
16	100.00	21.76%	$ 21.76
17	100.00	19.78%	$ 19.78
18	100.00	17.99%	$ 17.99
19	100.00	16.35%	$ 16.35
20	100.00	14.86%	$ 14.86
21	100.00	13.51%	$ 13.51
22	100.00	12.28%	$ 12.28
23	100.00	11.17%	$ 11.17
24	100.00	10.15%	$ 10.15
25	100.00	9.23%	$ 9.23
			$ 907.70

46/88

Uneven cash flows

- Non-constant cash flows

1. Annuity plus additional final payment
2. Irregular cash flows

47/88

Annuity plus additional final payment

N	5		
i	12%	Payment =	$ 100.00
N	Payment	PVIF	PV
1	100.00	89.29%	$ 89.29
2	100.00	79.72%	$ 79.72
3	100.00	71.18%	$ 71.18
4	100.00	63.55%	$ 63.55
5	1,100.00	56.74%	$ 624.17
			$ 927.90

48/88

8

Irregular Cash Flows

N	5		
i	12%	Payment =	$ 100.00
N	Payment	PVIF	PV
1	100.00	89.29%	$ 89.29
2	300.00	79.72%	$ 239.16
3	300.00	71.18%	$ 213.53
4	300.00	63.55%	$ 190.66
5	500.00	56.74%	$ 283.71
			$1,016.35

49/88

Future value of an uneven cash flow stream

N	5		
i	12%		
N	Payment	FVIF	FV
1	100	157%	$ 157.35
2	300	140%	$ 421.48
3	300	125%	$ 376.32
4	300	112%	$ 336.00
5	500	100%	$ 500.00
			$ 1,791.15

50/88

Solving for *i* with uneven cash flows

- A trial-and-error process
  - Using financial calculator
  - Using *Excel*'s IRR function

51/88

Solving for *i* with uneven CFs

i	12.5465%		
N	Payment	PVIF	PV
1	100.00	88.85%	$ 88.85
2	300.00	78.95%	$ 236.84
3	300.00	70.15%	$ 210.44
4	300.00	62.33%	$ 186.98
5	500.00	55.38%	$ 276.89
		Cost	$1,000.00

52/88

Finding interest rates, *i* Ordinary Annuity

N	5	Future Value	$ 10,000.0000
i	25.783945%	PMT =	$1,200
N	Payment	FVIF	FV
1	1,200.0000	250%	$ 3,003.8766
2	1,200.0000	199%	$ 2,388.1240
3	1,200.0000	158%	$ 1,898.5921
4	1,200.0000	126%	$ 1,509.4073
5	1,200.0000	100%	$ 1,200.0000
		FV	$ 10,000.0000

53/88

Semiannual and other compounding periods: Comparing interest rates

- Nominal (quoted or stated) interest rate (i_{NOM}) 名目利率
  - stated in contracts
  - the annual percentage rate (APR)
- Periodic rate (i_{PER}) 期間利率
  - amount of interest charged each period
  - $i_{PER} = i_{NOM} / m$ (m:每年複利計息次數)
- Effective or equivalent annual rate (EAR) 有效年利率 = $(1 + i_{NOM} / m)^m - 1$

54/88

Semiannual & other compounding periods

- Annual compounding
  $FV = PMT(1 + i_{NOM})^n$
- Semiannual compounding
  $FV = PMT(1 + i_{NOM}/2)^{2n}$
- Quarterly compounding
  $FV = PMT(1 + i_{NOM}/4)^{4n}$
- Monthly compounding
  $FV = PMT(1 + i_{NOM}/12)^{12n}$
- Daily compounding
  $FV = PMT(1 + i_{NOM}/365)^{365n}$

55/88

Comparing interest rates

- An investment opportunity offers a nominal interest rate of 10.25% with annual compounding.
- Another one offers a nominal interest rate of 10% with semiannual compounding.
- No difference between them?

56/88

Comparing interest rates

- An investment opportunity offers a nominal interest rate of 10.25% with annual compounding.
- Another one offers a nominal interest rate of 10% with semiannual compounding.
- No difference between them.

$(1+10.25\%)^1 = 110.25\%$ $\left(1+\frac{10\%}{2}\right)^{1\times 2} = 110.25\%$

57/88

Fractional Time Periods

Suppose that you deposited $1 million in a bank that pays a nominal rate of 12 %. How much would you get from the bank after 274 days, i.e. 9 months?

- Based on a 365-day year 按日計息
- Based on a 12-month year 按月計息

58/88

Fractional Time Periods

Suppose that you deposited $1 million in a bank that pays a nominal rate of 12 %. How much would you get from the bank after 274 days, i.e. 9 months?

- Based on a 365-day year 按日計息
  - Periodical (daily) rate = 12%/365
  - Number of days = (9/12)365=273.75≒274
  - Ending amount = $100 (1+ 12%/365)^{274} = $109.4248
- Based on a 12-month year 按月計息

59/88

Fractional Time Periods

Suppose that you deposited $1 million in a bank that pays a nominal rate of 12 %. How much would you get from the bank after 274 days, i.e. 9 months?

- Based on a 365-day year 按日計息
  - Periodical (daily) rate = 12%/365
  - Number of days = (9/12)365=273.75≒274
  - Ending amount = $100 (1+ 12%/365)^{274} = $109.4248
- Based on a 12-month year 按月計息
  - Periodical (monthly) rate = 12%/12 = 1%
  - Ending amount = $100 (1+ 12%/12)^{9} = $109.3685

60/88

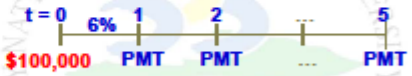
Loan Amortization 借(貸)款攤還

- Amortization tables are widely used for home mortgages, auto loans, business loans, retirement plans, etc.
- Fully amortized loan

An amortization schedule for a $100,000 6% annual rate loan with 5 equal annual payments.

61/88

Full Amortized Loan



62/88

Constructing a loan amortization table

	N	5		PV	$ 100,000
	i	6%		PMT =	$ 23,739.64
Amortization Table for the loan					
n	Loan amort.	Payment	Interest	Principal	Balance
1	$ 100,000.00	$ 23,739.64	$ 6,000.00	$ 17,739.64	$ 82,260.36
2	$ 82,260.36	$ 23,739.64	$ 4,935.62	$ 18,804.02	$ 63,456.34
3	$ 63,456.34	$ 23,739.64	$ 3,807.38	$ 19,932.26	$ 43,524.08
4	$ 43,524.08	$ 23,739.64	$ 2,611.44	$ 21,128.20	$ 22,395.89
5	$ 22,395.89	$ 23,739.64	$ 1,343.75	$ 22,395.89	$ 0.00

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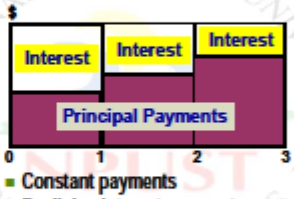
Where does the money go?



- Constant payments
- Declining interest payments
- Declining balance

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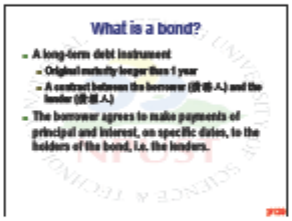
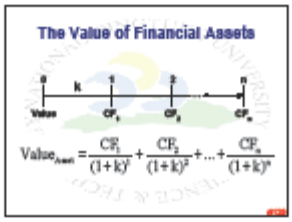
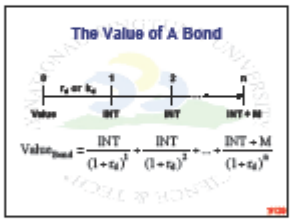
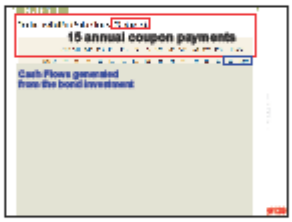
附件四：Bond Valuation　(共 15 頁)









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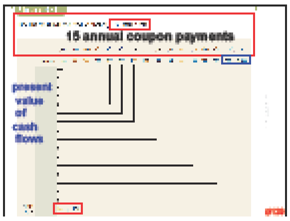
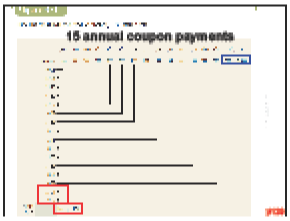
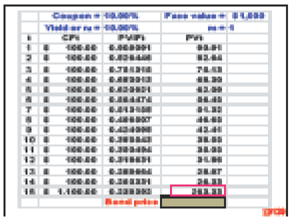
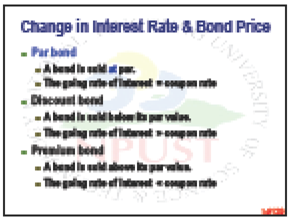

15 annual coupon payments
present value of cash flows

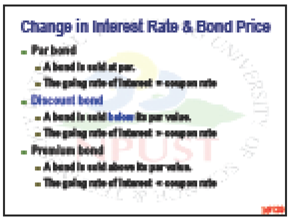

15 annual coupon payments


Bond price

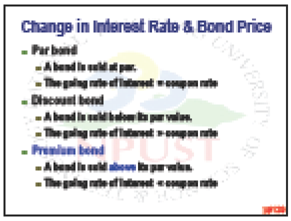

Bond price


Change in Interest Rate & Bond Price
Par bond
A bond is sold at par.
The going rate of interest = coupon rate
Discount bond
A bond is sold below its par value.
The going rate of interest > coupon rate
Premium bond
A bond is sold above its par value.
The going rate of interest < coupon rate


Bond price

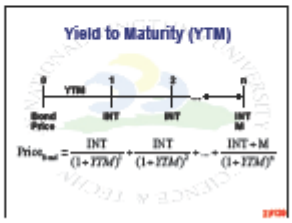

Change in Interest Rate & Bond Price
Par bond
A bond is sold at par.
The going rate of interest = coupon rate
Discount bond
A bond is sold below its par value.
The going rate of interest > coupon rate
Premium bond
A bond is sold above its par value.
The going rate of interest < coupon rate


Bond price

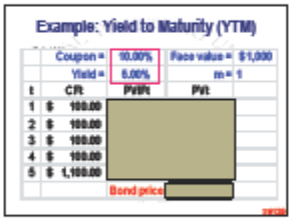

Change in Interest Rate & Bond Price
Par bond
A bond is sold at par.
The going rate of interest = coupon rate
Discount bond
A bond is sold below its par value.
The going rate of interest > coupon rate
Premium bond
A bond is sold above its par value.
The going rate of interest < coupon rate

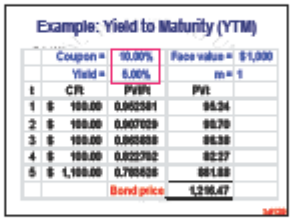

Coupon = 10.00%
Face value = $1,000
Yield or r = 6.00%
m = 1
t CR PVIFt PVt
1 $ 100.00 0.939936 93.99
2 $ 100.00 0.887336 88.73
3 $ 100.00 0.788353 78.85
4 $ 100.00 0.739330 73.93
5 $ 100.00 0.699853 69.99
6 $ 100.00 0.659170 65.92
7 $ 100.00 0.683490 68.35
8 $ 100.00 0.644268 64.43
9 $ 100.00 0.603345 60.33
10 $ 100.00 0.569193 56.92
11 $ 100.00 0.536953 53.69
12 $ 100.00 0.507114 50.71
13 $ 100.00 0.367698 36.77
14 $ 100.00 0.346851 34.69
15 $ 1,100.00 0.310343 341.37
Bond price 1,212.50

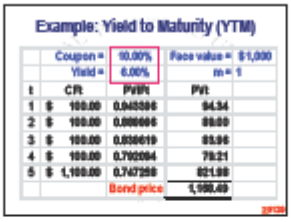

Bond Yields 債券收益率
Yield to maturity (YTM) 到期收益率
The rate of return earned on a bond if it is held to maturity
Yield to call (YTC) 提前收益率
Call price
Price of callable bond
Current yield 現行收益率
The annual interest payment on a bond divided by the bond's current price

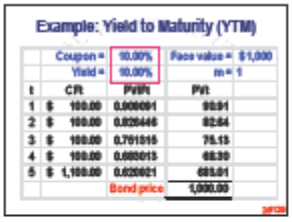

Yield to Maturity (YTM)
0
YTM
1
2
n
Bond Price
INT
INT
INT + M
$\text{Price}_{\text{bond}} = \frac{\text{INT}}{(1+YTM)^1} + \frac{\text{INT}}{(1+YTM)^2} + \cdots + \frac{\text{INT}+M}{(1+YTM)^n}$

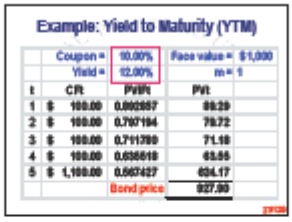

Coupon = 10.00%
Face value = $1,000
Yield or r = 6.00%
m = 1
t CR PVIFt PVt
1 $ 100.00 0.943381 94.34
2 $ 100.00 0.907029 90.70
3 $ 100.00 0.862838 86.28
4 $ 100.00 0.822702 82.27
5 $ 100.00 0.783626 78.36
6 $ 100.00 0.746215 74.62
7 $ 100.00 0.710681 71.07
8 $ 100.00 0.676839 67.68
9 $ 100.00 0.644609 64.46
10 $ 100.00 0.613913 61.39
11 $ 100.00 0.584679 58.47
12 $ 100.00 0.556837 55.68
13 $ 100.00 0.530321 53.03
14 $ 100.00 0.505068 505.07
Bond price 1,296.47


Example: Yield to Maturity (YTM)
Coupon = 10.00%
Face value = $1,000
Yield = 6.00%
m = 1
t CR PVIFt PVt
1 $ 100.00
2 $ 100.00
3 $ 100.00
4 $ 100.00
5 $ 1,100.00
Bond price

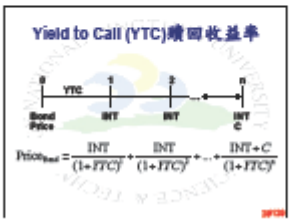

Example: Yield to Maturity (YTM)
Coupon = 10.00%
Face value = $1,000
Yield = 6.00%
m = 1
t CR PVIFt PVt
1 $ 100.00 0.943381 94.34
2 $ 100.00 0.907029 90.70
3 $ 100.00 0.862838 86.28
4 $ 100.00 0.822702 82.27
5 $ 1,100.00 0.783626 861.88
Bond price 1,296.47

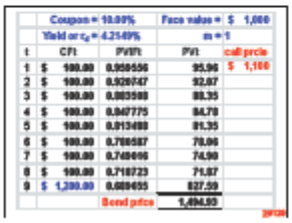

Example: Yield to Maturity (YTM)
Coupon = 10.00%
Face value = $1,000
Yield = 6.00%
m = 1
t CR PVIFt PVt
1 $ 100.00 0.943396 94.34
2 $ 100.00 0.889996 89.00
3 $ 100.00 0.839619 83.96
4 $ 100.00 0.792094 79.21
5 $ 1,100.00 0.747258 821.98
Bond price 1,166.49


Example: Yield to Maturity (YTM)
Coupon = 10.00%
Face value = $1,000
Yield = 10.00%
m = 1
t CR PVIFt PVt
1 $ 100.00 0.909091 90.91
2 $ 100.00 0.826446 82.64
3 $ 100.00 0.751315 75.13
4 $ 100.00 0.683013 68.30
5 $ 1,100.00 0.620921 683.01
Bond price 1,000.00

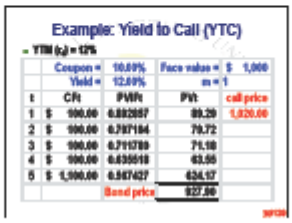

Example: Yield to Maturity (YTM)
Coupon = 10.00%
Face value = $1,000
Yield = 12.00%
m = 1
t CR PVIFt PVt
1 $ 100.00 0.892857 89.29
2 $ 100.00 0.797194 79.72
3 $ 100.00 0.711780 71.18
4 $ 100.00 0.635518 63.55
5 $ 1,100.00 0.567427 624.17
Bond price 927.90

3





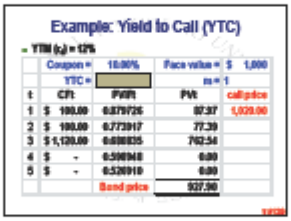
	Coupon =	10.00%	Face value =	$ 1,000
	Yield or r_d =	4.2549%	m =	1
t	CFt	PVIFt	PVt	call price
1	$ 100.00	0.959556	95.96	$ 1,100
2	$ 100.00	0.920747	92.07	
3	$ 100.00	0.883588	88.35	
4	$ 100.00	0.847775	84.78	
5	$ 100.00	0.813488	81.35	
6	$ 100.00	0.780587	78.06	
7	$ 100.00	0.748996	74.90	
8	$ 100.00	0.718723	71.87	
9	$ 1,100.00	0.689655	827.59	
		Bond price	1,494.93	



Example: Yield to Call (YTC)

- YTM (r_d) = 12%

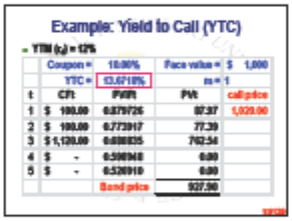
	Coupon =	10.00%	Face value =	$ 1,000
	Yield =	12.00%	m =	1
t	CFt	PVIFt	PVt	call price
1	$ 100.00	0.892857	89.29	1,020.00
2	$ 100.00	0.797194	79.72	
3	$ 100.00	0.711780	71.18	
4	$ 100.00	0.635518	63.55	
5	$ 1,100.00	0.567427	624.17	
		Bond price	927.90	



Example: Yield to Call (YTC)

- YTM (r_d) = 12%

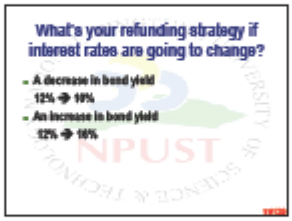
	Coupon =	10.00%	Face value =	$ 1,000
	YTC =		m =	1
t	CFt	PVIFt	PVt	call price
1	$ 100.00	0.879726	87.97	1,020.00
2	$ 100.00	0.773917	77.39	
3	$ 1,120.00	0.680835	762.54	
4	$ -	0.598948	0.00	
5	$ -	0.526910	0.00	
		Bond price	927.90	



Example: Yield to Call (YTC)

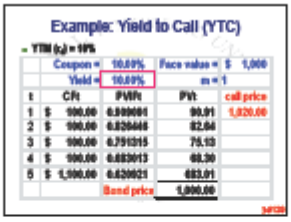
- YTM (r_d) = 12%

	Coupon =	10.00%	Face value =	$ 1,000
	YTC =	13.6718%	m =	1
t	CFt	PVIFt	PVt	call price
1	$ 100.00	0.879726	87.97	1,020.00
2	$ 100.00	0.773917	77.39	
3	$ 1,120.00	0.680835	762.54	
4	$ -	0.598948	0.00	
5	$ -	0.526910	0.00	
		Bond price	927.90	



What's your refunding strategy if interest rates are going to change?

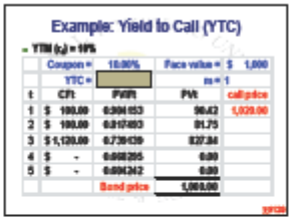
- A decrease in bond yield
  12% → 10%
- An increase in bond yield
  12% → 16%



Example: Yield to Call (YTC)

- YTM (r_d) = 10%

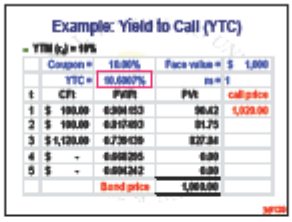
	Coupon =	10.00%	Face value =	$ 1,000
	Yield =	10.00%	m =	1
t	CFt	PVIFt	PVt	call price
1	$ 100.00	0.909091	90.91	1,020.00
2	$ 100.00	0.826446	82.64	
3	$ 100.00	0.751315	75.13	
4	$ 100.00	0.683013	68.30	
5	$ 1,100.00	0.620921	683.01	
		Bond price	1,000.00	



Example: Yield to Call (YTC)

- YTM (r_d) = 10%

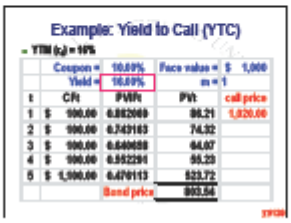
	Coupon =	10.00%	Face value =	$ 1,000
	YTC =		m =	1
t	CFt	PVIFt	PVt	call price
1	$ 100.00	0.909091	90.91	1,020.00
2	$ 100.00	0.826446	82.64	
3	$ 100.00	0.751315	75.13	
4	$ 100.00	0.683013	68.30	
5	$ 1,100.00	0.620921	683.01	
		Bond price	1,000.00	

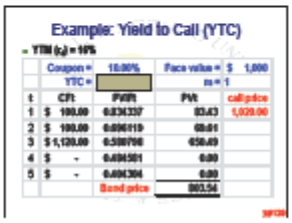


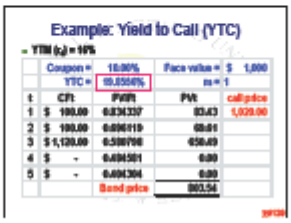
Example: Yield to Call (YTC)

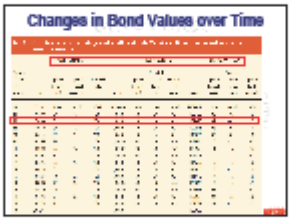
- YTM (r_d) = 10%

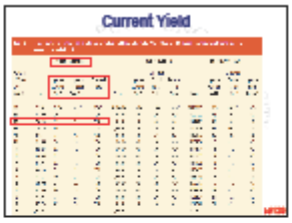
	Coupon =	10.00%	Face value =	$ 1,000
	YTC =	10.0000%	m =	1
t	CFt	PVIFt	PVt	call price
1	$ 100.00	0.909091	90.91	1,020.00
2	$ 100.00	0.826446	82.64	
3	$ 100.00	0.751315	75.13	
4	$ 100.00	0.683013	68.30	
5	$ 1,100.00	0.620921	683.01	
		Bond price	1,000.00	

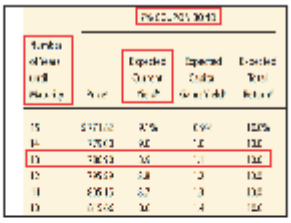

Example: Yield to Call (YTC)


Example: Yield to Call (YTC)


Example: Yield to Call (YTC)


Changes in Bond Values over Time


Current Yield



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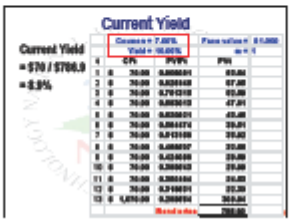
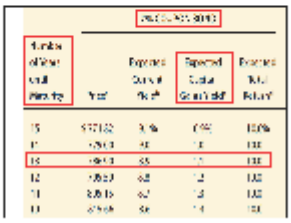
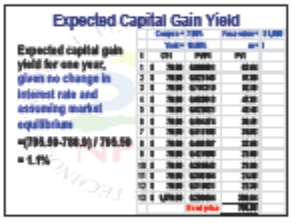
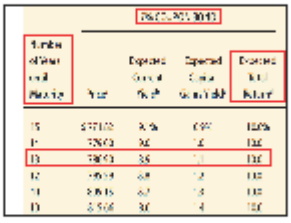
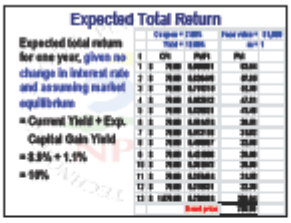

Current Yield
Current Yield
= $70 / $706.9
= 9.9%

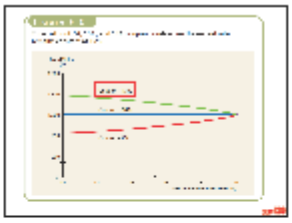

Expected Capital Gain Yield
Expected capital gain yield for a year, given no change in interest rate and assuming market equilibrium
= ?




Expected Capital Gain Yield
Expected capital gain yield for one year, given no change in interest rate and assuming market equilibrium
=(799.59-706.9) / 706.59
= 1.1%




Expected Total Return
Expected total return for one year, given no change in interest rate and assuming market equilibrium
= Current Yield + Exp. Capital Gain Yield
= 9.9% + 1.1%
= 11%



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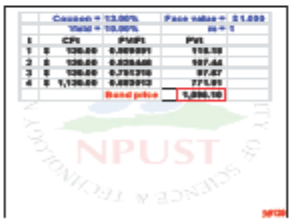

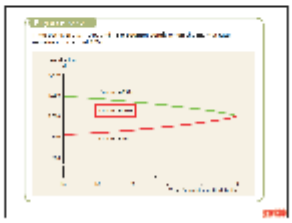

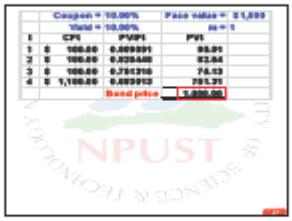

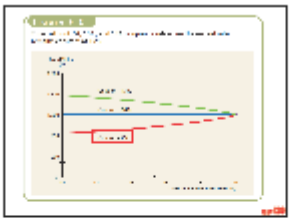

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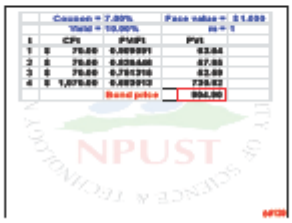
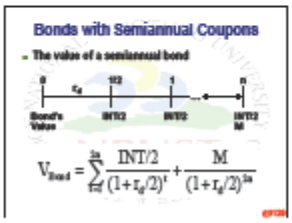
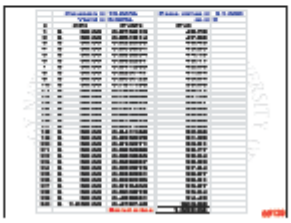
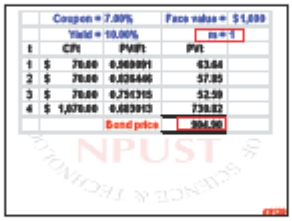

Coupon = 7.00%
Face value = $1,000
Yield = 10.00%
n = 1
t CFt PVIFt PVt
1 $ 70.00 0.909091 63.64
2 $ 70.00 0.826446 57.85
3 $ 70.00 0.751315 52.59
4 $ 1,070.00 0.683013 730.82
Bond price 904.90


Bonds with Semiannual Coupons
The value of a semiannual bond
0
r_d
1/2
1
n
Bond's Value
INT/2
INT/2
INT/2 M
$V_{Bond} = \sum_{t=1}^{2n} \frac{INT/2}{(1+r_d/2)^t} + \frac{M}{(1+r_d/2)^{2n}}$

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Yield = 10.00%
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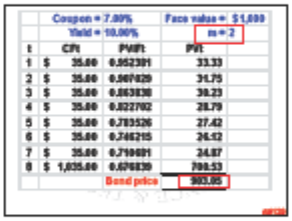
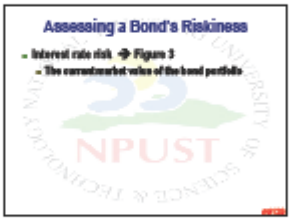
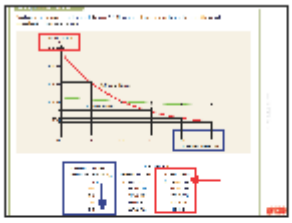
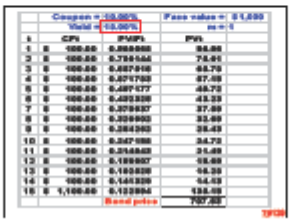
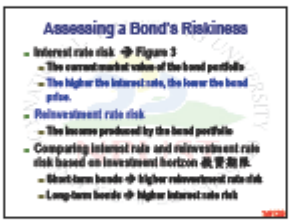

Coupon = 7.00%
Face value = $1,000
Yield = 10.00%
n = 2
t CFt PVIFt PVt
1 $ 35.00 0.952381 33.33
2 $ 35.00 0.907029 31.75
3 $ 35.00 0.863838 30.23
4 $ 35.00 0.822702 28.79
5 $ 35.00 0.783526 27.42
6 $ 35.00 0.746215 26.12
7 $ 35.00 0.710681 24.87
8 $ 1,035.00 0.676839 700.53
Bond price 903.05


Assessing a Bond's Riskiness
Interest rate risk → Figure 3
The current market value of the bond portfolio



8

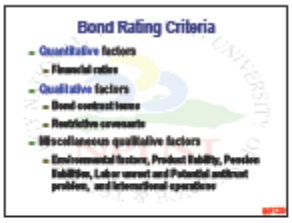


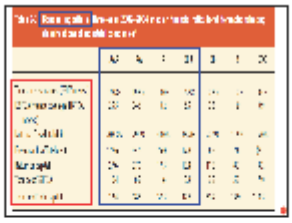

Assessing a Bond's Riskiness
Interest rate risk
Figure 3
The current market value of the bond portfolio
The higher the interest rate, the lower the bond price.
Reinvestment rate risk
The income produced by the bond portfolio
Comparing interest rate and reinvestment rate risk based on investment horizon
Short-term bonds
higher reinvestment rate risk
Long-term bonds
higher interest rate risk


Default Risk
We discuss bond's default risk in terms of:
Various types of corporate bonds
Bond ratings
Bankruptcy
and reorganization


Various Types of Corporate Bonds
Mortgage bonds
Debentures
Subordinated debentures
Investment-grade bonds
Junk bonds


Bond Ratings
Based on both qualitative and quantitative factors, bond ratings are designed to reflect the probability of a bond issue going into default.
Rating Agency
Investment-Grade Bonds
Junk Bonds
Moody's
Aaa Aa A Baa
Ba B Caa C
S&P
AAA AA A BBB
BB B CCC D


Bond Rating Criteria
Quantitative factors
Financial ratios
Qualitative factors
Bond contract terms
Restrictive covenants
Miscellaneous qualitative factors
Environmental factors, Product liability, Pension liabilities, Labor unrest and Potential antitrust problem, and International operations



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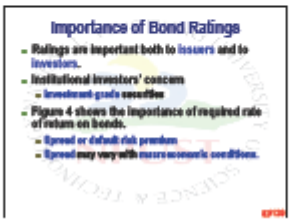
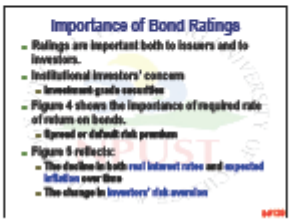

Importance of Bond Ratings
Ratings are important both to issuers and to investors.
Institutional investors' concern
investment-grade securities
Figure 4 shows the importance of required rate of return on bonds.
Spread or default risk premium
Spread may vary with macroeconomic conditions.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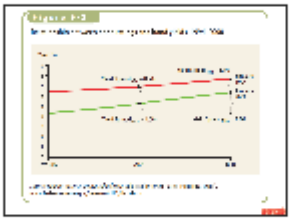
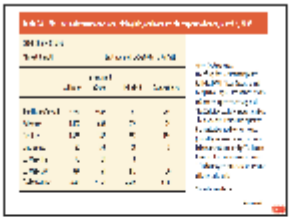
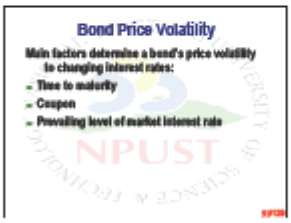
Spread or default risk premium
Figure 5 reflects:
The decline in both real interest rates and expected inflation over time
The change in investors' risk aversion

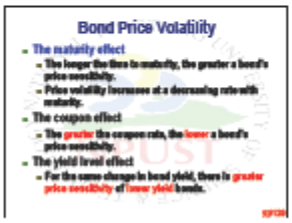


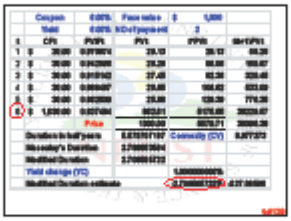

Bankruptcy 倒閉 and Reorganization 重整
Insolvency
A business does not have enough cash to meet its interest and principal payments.
The choice of insolvency case
(Chapter 11) Reorganization → restructuring the debt
(Chapter 7) Liquidation 清算
Typically, a company wants Chapter 11, while creditors may prefer Chapter 7.

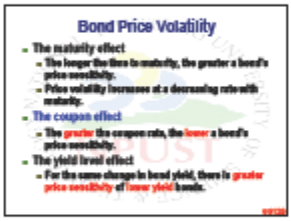

Bond Markets
Corporate bonds are traded primarily in the OTC market.
Information on bond markets in the OTC market is not published.
Some bonds are listed and traded on the bond division of the NYSE.
Table 4 shows the "corporate bonds" section from The Wall Street Journal.
Coupon rates are set at levels that reflect the going rate of interest on the day the bonds are issued.




Bond Price Volatility
Main factors determine a bond's price volatility to changing interest rates:
Time to maturity
Coupon
Prevailing level of market interest rate


Bond Price Volatility
The maturity effect
The longer the time to maturity, the greater a bond's price sensitivity.
Price volatility increases at a decreasing rate with maturity.
The coupon effect
The greater the coupon rate, the lower a bond's price sensitivity.
The yield level effect
For the same change in bond yield, there is greater price sensitivity of lower yield bonds.

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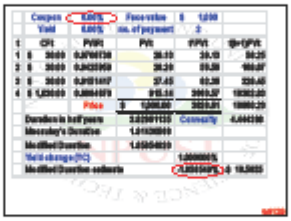

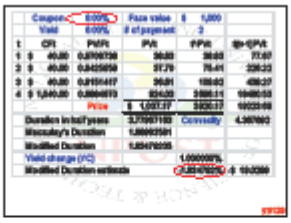

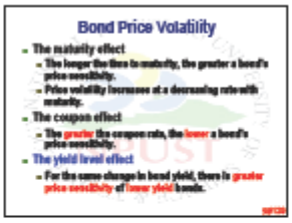
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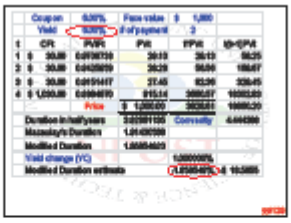


Bond Price Volatility

The Duration Measure:

- Price volatility of a bond varies inversely with its coupon and directly with its term to maturity.
- A composite measure considering both coupon and maturity
- Developed by Frederick R. Macaulay (1938)

Macaulay Duration

$$D_{Mac} = \frac{\sum_{t=1}^{n} \frac{t \times CF_t(t)}{(1+Y_M)^t}}{\sum_{t=1}^{n} \frac{CF_t}{(1+Y_M)^t}} = \frac{\sum_{t=1}^{n} t \times PV_t}{\text{Price}}$$

where,

D_{Mac} = Macaulay duration

t = time period in which the coupon or principal payment occurs

CF_t = interest or principal payment that occurs in period t

Y_M = yield to maturity on the bond

Duration公式之推導

$$P = \frac{C}{(1+R)^1} + \frac{C}{(1+R)^2} + \ldots + \frac{C+F}{(1+R)^N}$$

$$\frac{dP}{dR} = \frac{-C}{(1+R)^1} + \frac{-2C}{(1+R)^2} + \ldots + \frac{-N(C+F)}{(1+R)^{N+1}}$$

$$\frac{dP}{dR} = -\frac{1}{(1+R)}\left[\frac{C}{(1+R)^1} + \frac{2C}{(1+R)^2} + \ldots + \frac{N(C+F)}{(1+R)^N}\right]$$

Duration公式之推導

$$\frac{dP}{dR} = \frac{1}{(1+R)}\left[\frac{C}{(1+R)^1} + \frac{2C}{(1+R)^2} + \ldots + \frac{N(C+F)}{(1+R)^N}\right]$$

$$D = \frac{\frac{C}{(1+R)^1} + \frac{2C}{(1+R)^2} + \ldots + \frac{N(C+F)}{(1+R)^N}}{P}$$

$$D \times P = \frac{C}{(1+R)^1} + \frac{2C}{(1+R)^2} + \ldots + \frac{N(C+F)}{(1+R)^N}$$

$$\Rightarrow \frac{dP}{dR} = \frac{1}{(1+R)}[D \times P]$$

Bond Price and Interest Rates

$$\frac{dP}{dR} = -\frac{1}{(1+R)}[D \times P]$$

$$\Rightarrow \frac{\Delta P}{\Delta R} = -\frac{1}{(1+R)}[D \times P] = -\frac{D}{(1+R)} \times P$$

$$\Delta P = -\frac{D}{(1+R)} \times \Delta R \times P$$

Modified Duration
修正後存續期間

$$D_{mod} = D_{Mac} \times \left(\frac{1}{1+R/m}\right)$$

where

D_{mod} = the modified duration of the bond

D_{Mac} = the Macaulay duration of the bond

R = interest rate

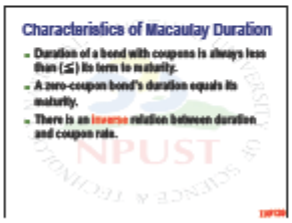
m = the number of coupon payments each year

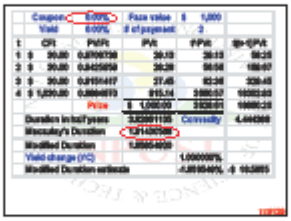
Bond Price and Interest Rates
債券價格與利率變動之關係

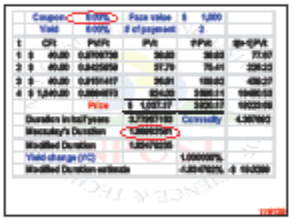
$$\frac{\Delta P}{P} = -D_{Mac} \times \frac{\Delta R}{1+\frac{R}{m}} = -\frac{D_{Mac}}{1+\frac{R}{m}} \times \Delta R$$

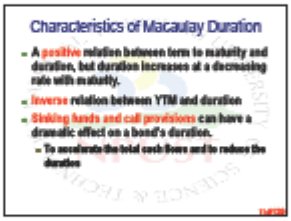
$$= -D_{mod} \times \Delta R$$

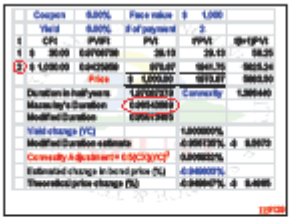
$$\Rightarrow \Delta P = -D_{mod} \times \Delta R \times P$$

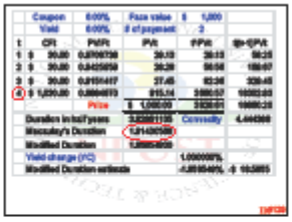

Characteristics of Macaulay Duration
- Duration of a bond with coupons is always less than (≤) its term to maturity.
- A zero-coupon bond's duration equals its maturity.
- There is an inverse relation between duration and coupon rate.

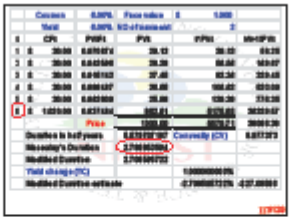





Characteristics of Macaulay Duration
- A positive relation between term to maturity and duration, but duration increases at a decreasing rate with maturity.
- Inverse relation between YTM and duration
- Sinking funds and call provisions can have a dramatic effect on a bond's duration.
- To accelerate the total cash flows and to reduce the duration







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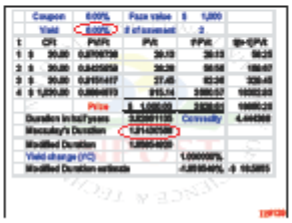
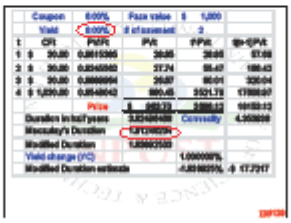




Duration and Bond Price Volatility

Bond price movements will vary with modified duration for small changes in yields:

$$\frac{\Delta P}{P}\% \equiv -D_{\text{mod}} \times \Delta Y_{\text{m}}$$

Where:

ΔP = change in price for the bond

P = beginning price for the bond

D_{mod} = the modified duration of the bond

ΔY_{m} = yield change in basis points divided by 100

Bond Convexity

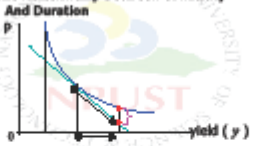
- The percentage price change formula using duration is a linear approximation of bond price change for small changes in market yields

$$\frac{\Delta P}{P}\% \equiv -D_{\text{mod}} \times \Delta Y_{\text{m}}$$

- Price changes are not linear, but a curvilinear (convex) function.

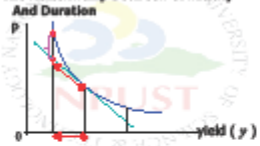
Bond Convexity

The Relationship Between Convexity And Duration



Bond Convexity

The Relationship Between Convexity And Duration



Bond Convexity

- The measure of the curvature
- Convexity is the percentage change in dP/dy for a given change in yield.
- It is the second derivative of bond price with respect to yield (d^2P/dy^2).

$$\text{Convexity} = \frac{d^2P/dT^2}{P}$$

$$= \left[\frac{1}{P(1+y^2)}\right]\left[\sum_{t=1}^{n}\left[\frac{t}{(1+y^2)}\right](t^2+t)\right]$$

	Coupon	6.00%	Face value	$ 1,000
	Yield	6.00%	# of payment	3
t	CFt	PVIFt	PVt	t*PVt
1	$ 30.00	0.9709738	28.13	28.13
2	$ 30.00	0.9425959	28.29	56.58
3	$ 30.00	0.9151417	27.45	82.36
4	$ 1,030.00	0.8884870	915.14	3663.57
		Price	$ 1,000.00	3830.61
	Duration in half years		3.825861135	Convexity
	Macaulay's Duration		1.91430569	4.444388
	Modified Duration		1.89564823	
	Yield chanse (YC)			0.250000%
	Modified Duration estimate			-0.474607%
	Convexity Adjustment = 0.5(C)(Δ(YC)²)			0.001396%
	Estimated change in bond price (%)			-0.473210%
	Actual price change (%)			-0.469282%

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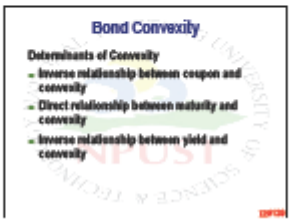

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Determinants of Convexity

- Inverse relationship between coupon and convexity
- Direct relationship between maturity and convexity
- Inverse relationship between yield and convexity

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