LECTURE 1: INTRODUCTION TO PRINCIPLES OF FINANCE

- **Financial system** – comprised of financial institutions, instruments, markets (facilitating transactions for goods and services + financial transactions)
  - Settle commercial transactions – domestic & international
  - Arrange **flow of funds** between **surplus** & **deficit** units (through contracts)
    - Funds can flow through **intermediaries** or through **financial markets (direct financing)**
  - Transfer and manage **risk**
  - Generate information to assist **decision making**
  - Deal with incentive problems in **contracting**
  - Pooling of **funds**

- **Surplus units** – suppliers of funds
  - Lenders
  - Investors
  - Shareholders

- **Deficit units** – users of funds / using someone else's money
  - Borrowers
  - Credit card users
  - Companies/issuers

- **Intermediation (indirect financing)** – transfer of funds between ultimate savers and ultimate borrowers via deposit-taking institutions
  - **Asset transformation** – borrowers and savers are offered a range of products
  - **Maturity transformation** – borrowers and savers are offered products with a range of terms to maturity (different time periods)
  - **Credit risk diversification and transformation** – saver's credit risk limited to the intermediary (which has expertise and information)
    - You only have to worry about the bank's situation – not the person who has loaned out your deposited money
  - **Economies of scale** – financial and operational benefits of organisational size and business volume

- **Direct financing** – transfer of funds from ultimate savers to ultimate borrowers without an intermediary
  - e.g. issuing shares & raising capital directly from shareholders
  - **ADVANTAGES:**
    - Avoids costs of intermediation
    - Increases access to diverse range of markets
    - Greater flexibility in range of securities users can issue for different financing needs
  - **DISADVANTAGES:**
    - Matching of preferences
    - Liquidity and marketability of a security
    - Search and transaction costs

- **Security** – financial contract that can be traded in a financial market which specifies:
    - **Asset involved** – commodity, hard asset, financial asset
    - **Quantity and unit** – thousand shares, ounce of gold
    - **Price, date and payment + settlement terms**

- **Primary markets** – securities are issued for the first time
    - Investors purchase securities directly from the issuer
    - Direct financing raises funds in **larger amounts** because the issue of securities requires a substantial effort that is only economical for large amounts

- **Secondary markets** – the buying and selling of existing financial securities between investors
    - No new funds raised = no direct impact on original issuer of security
    - Transfer of ownership from one saver to another saver
    - Provides liquidity
        - Facilitates the restructuring of portfolios of security owners
    - It does not raise funds for issuers… greatly assists operations of primary market
    - Provides investors with liquidity
        - Transforms the maturity of funds
    - **Price discovery** – identify the price (or value) of the securities
    - Identify investors who are interested in securities (who could be approached to supply funds in the primary market)

DIFFERENT TYPES OF FIRMS

- **Limited liability companies** – separate legal entity from its owners
    - Limits owners **liability** to their investment
    - **Taxed** in its own right and can be sued in its own rights
    - Can be public (trade on an exchange) or private (banned from being traded on an exchange)
    - Usually run by professional managers (agents) on behalf of the owners – especially for public limited liability companies
        - Incentive of managers may not always be aligned with the owners!

- **Sole proprietorships** – no separation between owner and the firm
    - Unlimited **liability**
    - **Taxed** as same entity
    - Business is owned and run by one person with some employees
    - Easy to set up
    - Agency issues are not a big problem
    - Size of business limited by owner's wealth and their ability to borrow

- **Partnerships** – a sole proprietorship with multiple owners
    - All partners are liable for the debts of the business
    - Combines wealth and abilities of multiple individuals
    - Easy to setup but a new partnership will need to be formed if an existing partner sells their stake or dies

FIVE FUNDAMENTAL CONCEPTS

- Finance focuses on cash flows & is **forward-looking**
  - Identify and value the future benefits and costs of a decision

- **Law of one price** – shares (which perform the same function) have to trade at the same price
  - Assumes minimal transaction costs

- **Arbitrage** – selling and buying shares simultaneously to take advantage of different prices in different markets
  - Selling expensive share whilst buying cheap share
  - Results in instantaneous riskless profit

- **Time value of money** – a dollar received today is different in value to that received in one year's time
  - Inflation means that your **purchasing power is diminished**

- The greater the **risk** of an investment, the higher the **expected return**
  - Expected return on a risky asset = risk-free rate + risk premium
    - The greater the risk, the greater the required risk premium

- Main goal of managers is to maximise the market value of the firm (maximise shareholder wealth)
  - **Value of firm** = present value of future expected cash flows

    $$\sum_{t=1}^{n} \frac{E(CF_t)}{(1+r)^t}$$

    $E(CF_t)$ = expected cash flows received at end of period t
    n = number of periods over which cash flows are received
    r = rate of return required by investors

  - **Shareholder wealth** = present value of shareholder's future expected cash flows

- **Simple interest** – the value of a cash flow is calculated without including any accrued interest to the principal

  $$F_n = P_0(1 + n \times r)$$

  $$P_0 = \frac{F_n}{1 + n \times r}$$

- **Compound interest (interest on interest)** – interest accrued is added to the principal and reinvested
  - Future value of a cash flow is calculated based on the principal and interest accrued

  $$F_n = P_0(1 + r)^n$$

  $$P_0 = \frac{F_n}{(1 + r)^n}$$

- **Effective interest rate** – the **annualised** rate that takes account of compounding within the year/period

$$i_e = \left(1 + \frac{r}{m}\right)^m - 1$$
$$i_e = e^r - 1$$

- *Example:* Assume the stated interest rate is 5% p.a. What is the *effective* ***annual*** interest rate if interest is paid: (a) semi-annually, (b) quarterly, (c) monthly, and (d) daily?
- Effective annual interest rates for different compounding intervals
- *Semi-Annual:* $i_e = (1 + 0.05/2)^2 - 1 = 0.0506 = 5.0625\%$
- *Quarterly:* $i_e = (1 + 0.05/4)^4 - 1 = 0.0509 = 5.0945\%$
- *Monthly:* $i_e = (1 + 0.05/12)^{12} - 1 = 0.0512 = 5.1162\%$
- *Daily:* $i_e = (1 + 0.05/365)^{365} - 1 = 0.05127 = 5.1267\%$

  - If the interest rate is $i\%\ p.a.$ but the interest is paid m times a year, after n years $\$P_0$ will have the following future value:

    $$S_n = P_0 \times \left(1 + \frac{r}{m}\right)^{m \times n}$$

    $\frac{r}{m}$ = per period interest rate

    $m \times n$ = total periods over which interest is compounded

  - *Example:* Suppose your ancestor saved $1,000 one hundred years ago with interest compounded monthly. What would its (future) value be today at an interest rate of (a) 5% and (b) 7% p.a?
  - Here, $m = 12$ and $m \times n = 1200$
  - At 5% p.a., FV = $1000(1 + 0.05/12)^{1200}$ = $146,880
  - At 7% p.a., FV = $1000(1 + 0.07/12)^{1200}$ = $1,074,555!

- Present and future values of a cash flow depend on the following factors:
  - **The time period (n)**
    - Future value increases as n increases
    - Present value decreases as n increases
  - **The interest rate (r)**
    - Future value increases as r increases
    - Present value decreases as r increases
  - **The method of computing interest**
    - Future value increases as the compounding frequency increases
    - Present value decreases as the compounding frequency increases

LECTURE 2: INTRODUCTION TO FINANCIAL MATHEMATICS AND DEBT

- *Example:* You invest \$10,000 for a five year period. What interest rate do you need to earn for the funds to double in that time period? If you invest \$10,000 at an interest rate of 10% p.a. how long will it take for these funds to triple in value?
- In the first case we have an *unknown* interest rate, r
  - $P_0 = \$10{,}000$, $F_5 = \$20{,}000$, $n = 5$
- $10000(1 + r)^5 = 20000$
- So, $(1 + r)^5 = 20000/10000 = 2$
- $r = 2^{1/5} - 1 = 14.9\%$

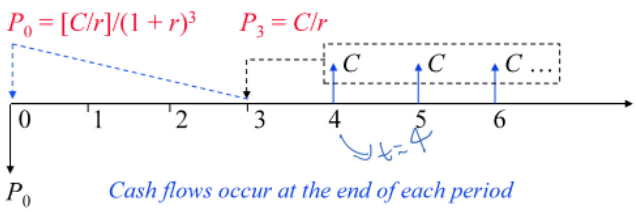
- In the second case we have an *unknown* time period, n
  - $P_0 = \$10{,}000$, $F_n = \$30{,}000$, $r = 10\%$
- $10000(1.10)^n = 30000$
- So, $(1.10)^n = 30000/10000 = 3.00$
- Taking natural logs we have…
- $n \times ln(1.10) = ln(3.00)$
- So, $n = 1.0986/0.0953 = 11.5$ years

VALUING PERPETUITIES

- **Perpetuity** – equal, periodic cash flow that goes on forever

  $$P_0 = \frac{C}{r}$$

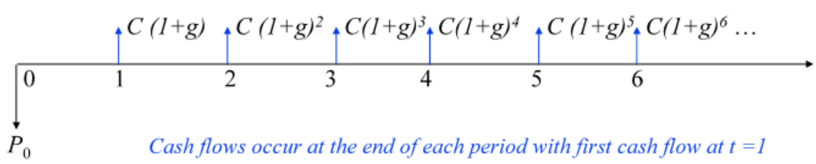
- **Deferred perpetuity** – equal, periodic cash flow that starts at some future date and then goes on forever



  - Present value of a perpetuity deferred to the end of time $n + 1$

    $$P_0 = \frac{C/r}{(1 + r)^n}$$

- **Growth perpetuity** – perpetuity of C dollars today growing at a constant rate of g percent per period



(first cash flow assumed to be $C(1 + g)$ not C)

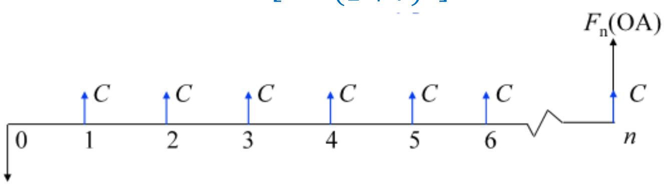
$P_0 = C(1+g)/(r-g)$

- *Example:* Your company can lease a computer system for an annual lease payment of \$1,800 ***now*** with lease payments increasing at a constant annual rate of 2 percent ***forever***, or purchase it today for \$25,000. Assume an interest rate of 10 percent per annum. Ignoring taxes and other complications, what should the company do?
- First cash flow of growth perpetuity:
  - A cash flow of \$1,800 *now* implies that $C(1+g)$ = \$1,800*1.02= \$1836 is the cash flow at t=1
- The present value of the lease payments is:
  - P_0 = \$1800 + PV of Growth Perpetuity
  - P_0 = \$1800 + (1800*1.02)/(0.10 – 0.02)
  - Total cost = \$1800 + \$22,950 =\$24,750.
- The company will ***lease*** the computer as less than \$25,000

VALUING ORDINARY ANNUITIES

- **Ordinary annuity –** series of equal, periodic cash flows occurring at the **end of each period** and lasting **for n periods** with **n cash flows**

$$P_0(OA) = [C/r]\left[1 - \frac{1}{(1+r)^n}\right]$$



Cash flows occur at the end of each period with first cash flow at t=1

$$F_n(OA) = [C/r]\left[1 - \frac{1}{(1+r)^n}\right](1+r)^n$$

- *Example:* Suppose you invest \$1,000 every year for (i) 10 years and (ii) 50 years earning an annual return of 10%.

  a) What is each investment's value at the point where you stop investing?

  b) What are the present values of your investments in part (a)?

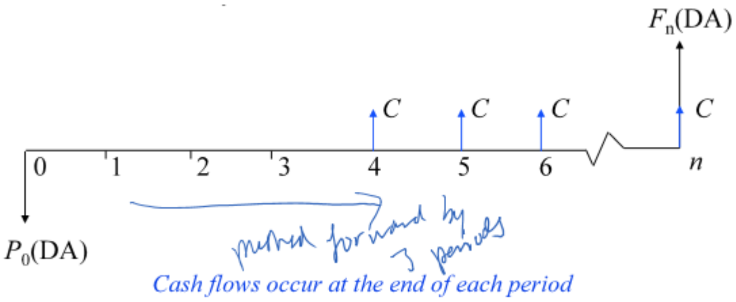
  c) What is the general relation between the future and present values calculated in parts (a) and (b)?

  a) Future values at the end of 10 and 50 years
  - *In 10 years:* F_{10} = [1000/0.10][1.10^{10} – 1] = \$15,937
  - *In 50 years:* F_{50} = [1000/0.10][1.10^{50} – 1] = \$1,163,909

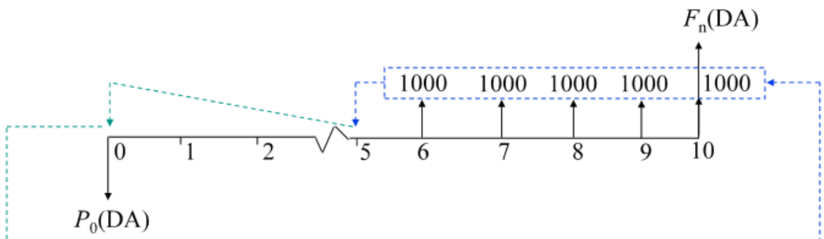
  b) Present values of the above investments
  - *Over 10 years:* P_0 = [1000/0.10][(1 – 1.10^{-10}] = \$6,145
  - *Over 50 years:* P_0 = [1000/0.10][(1 – 1.10^{-50}] = \$9,915

  c) If you had invested \$9,915 for a 50 year period, it would be worth \$1,163,909 at a 10% return p.a.
  - 9915(1.1)^{50} = \$1,163,930 (rounding error)

- **Deferred ordinary annuity** – series of equal, periodic cash flows occurring at the **end of each period** where the first cash flow occurs at a future date



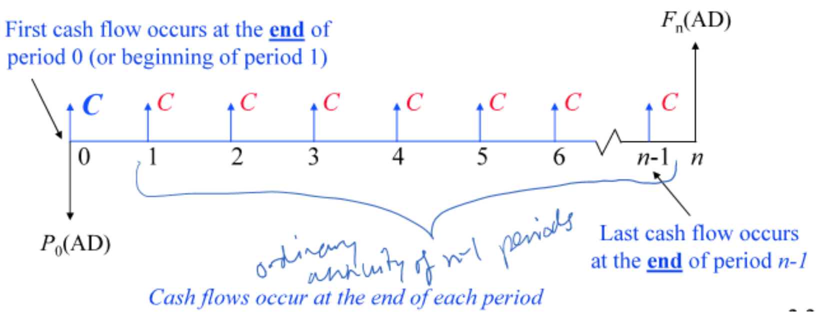
- *Example:* Suppose you plan to invest $1,000 every year for five years and earn a return of 10% p.a. but wish to defer the investment until the end of year 6. That is, no funds are invested during years 1 - 5. What is the future value of your investment at the end of year 10 and what is the present value of your investment today?



- Future value of deferred annuity at the end of year 10
  - $F_{10} = [1000/0.10][1.10^5 - 1] = \$6,105$
- Present value of deferred annuity
  - $P_5 = [1000/0.10][1 - 1.10^{-5}] = \$3,791$
  - $P_0 = 3791/(1 + 0.10)^5 = \$2,354$

VALUING ANNUITIES DUE

- **Annuity due** – series of equal, periodic cash flows occurring at the **beginning of each period**
  - There are $\boldsymbol{n}$ **cash flows** but only $\boldsymbol{n-1}$ **periods**
  - Effectively move annuity back one period on our standard timeline



- Present value = $P_0(OA)$ plus cash flow in year 0

$$P_0(AD) = C + [C/r]\left[1 - \frac{1}{(1+r)^{n-1}}\right]$$

$$F_{n-1}(AD) = \left\{C + [C/r]\left[1 - \frac{1}{(1+r)^{n-1}}\right]\right\}(1+r)^{n-1}$$

- *Example:* Suppose you deposited $1,000 every year but at the *beginning* of each year. What are the present values of these deposits earning a 10% p.a. return after (a) 10 deposits and (b) 50 deposits? What are their future values after the final deposit? Present values of the investments are…
  - Over 10 years: $P_0 = 1000 + [1000/0.10][1 - 1.10^{-9}] = \$6,759$
  - Over 50 years: $P_0 = 1000 + [1000/0.10][1 - 1.10^{-49}] = \$10,906$
- Future values after 10 (at t= 9) and 50 (at t= 49) deposits are…
  - $F_{10} = P_0[1.10^9] = \$6759 * [1.10^9] = \$15937.37$
  - $F_{50} = P_0[1.10^{49}] = \$10906 * [1.10^{49}] = \$1,163,876.95$

APPLICATIONS

- *Application:* You have borrowed $20,000 from your bank with the loan to be repaid in equal *annual* installments over four years. Your bank charges an annual interest rate of 10% p.a. with interest compounded annually

  a) What annual payment would you be making on this loan?

  b) Develop a loan amortization schedule for this loan. Then using this schedule obtain the following information

  (i) The principal balance outstanding at the end of year 1

  (ii) The total interest paid in year 2

  (iii) The total principal repaid in year 3

  a) The annual payments are based on the loan amount which is equal to the present value of the remaining payments
  - Loan amount at any point = PV(Remaining payments)
  - $20000 = \text{Payment} \times [1 - 1.10^{-4}]/0.10 = \text{Payment} \times 3.16987$
  - So, Payment = 20000/3.16987 = $6,309.42

  b) The loan amortization schedule shows the interest paid, principal repaid and principal remaining over the loan's duration. It can be obtained using the following:
  - Interest paid = (Previous period's principal) × (Interest rate)
  - Principal repaid = Loan Payment – Interest paid
  - Principal remaining = Previous period's principal – Principal repaid

Ordinary annuity:

$$P_0(OA) = [C/r]\left[1 - \frac{1}{(1+r)^n}\right]$$

$r = 10\%$

$n = 4$

$C = ?$

$P_0 = 20,000$

Year	Annual payment	Interest paid[1]	Principal repaid[2]	Principal remaining[3]
0	–	–	–	$20,000.00
1	$6,309.42	$2,000.00	$4,309.42	$15,690.58 (3)
2	$6,309.42	$1,569.06 (1)	$4,740.36	$10,950.22
3	$6,309.42	$1,095.02	$5,214.40 (2)	$5,735.82
4	$6,309.42	$573.58	$5,735.84	$0.00
Totals	$25,237.66	$5,237.66	$20,000.00	

[1] Interest paid = Previous period's principal × Interest rate
[2] Principal repaid = Loan Payment – Interest paid
[3] Principal remaining = Previous period's principal – Principal repaid
Note: The principal outstanding at the end of year 1 can also be computed as the present value of the *remaining* payments, $P_1 = \text{Payment} \times \{[1 - 1.10^{-3}]/0.10\}$

LECTURE 3: DEBT AND EQUITY

- **Debt** – interest and principal must be paid as promised
    - Lenders rank higher than equity holders (must be paid from operational cash flows before any distribution can be made to equity holders)

- **Equity** – dividends do not have to be paid
    - Equity holders are paid last (**residual claimants**) after all other stakeholders are paid

- **Capital structure** – mix of funding sources that it uses
    - How much debt and how much equity?

DEBT SECURITIES

- **Debt security** – loan that can traded in the (secondary) market
    - Bonds, debentures, notes, bills of exchange
    - May be issued by government and private entities

    1. Is it short-term or long-term?
    2. Does it consist of one or many future cash flows?
    3. Is it quoted and traded using simply interest of compound interest?

    - Does the issuer (borrowers) have the right to repay early if they want to?
    - Is the loan secured against assets (collateral) of the borrower or unsecured?

- **Short-term debt securities**
    - Term is less than **1 year** (usually less than 6 months)
    - **Single** future cash flow
    - Quoted and traded using **simple interest**

    - **Types of short-term debt securities in Australia:**
        - Treasury notes (government debt)
        - Bills of exchange (private debt – usually guaranteed by a bank)
        - Promissory notes (private debt – not guaranteed by a bank)

        - Term of 6 months or less
        - Single payment (**face value**) on the maturity date
        - Securities are traded using simple interest on a **yield** basis in the secondary market

- **Treasury notes**

  Example of primary market pricing

  The government (through the Reserve Bank) issues a 13-week Treasury note.
  It is bought by Unisuper, a superannuation fund.
  The note has a face value of $10,000,000 and is issued at a yield of 7.650% pa.
  What is the price? (That is, how much has the government borrowed?)

Answer

- The term of the note is measured precisely as the fraction of a year.
  - 13 weeks is 91 days, so the term of the note in years is 91/365.
- The holder of the note (the lender) will be paid $10,000,000 on the maturity date.
- The price of the note is its present value, calculated using a simple interest rate of 7.650% pa.

The formula for present value, using simple interest is:

$$P = \frac{F_n}{1 + rn}.$$

$F = 10{,}000{,}000$
$r = 7.650\%$
$n = \frac{91}{365}$

Therefore:

$$P = \frac{\$10{,}000{,}000}{1 + 0.0765 \times \frac{91}{365}}$$

$$= \frac{\$10{,}000{,}000}{1.019072603}$$

$$= \$9{,}812{,}844$$

Example of secondary market pricing

After holding the note for 3 weeks (21 days), Unisuper decided to sell the note in the secondary market to the Commonwealth Bank. Unisuper and the bank agreed that the note should be sold at a yield of 7.550% pa. This rate was determined by market conditions at the time.

How much will the Commonwealth Bank pay Unisuper?

Answer

We now have $r = 0.0755$ and $d = 91 - 21 = 70$ days.

F, of course, is unchanged at $10,000,000.

$$P = \frac{\$10{,}000{,}000}{1 + 0.0755\left(\frac{70}{365}\right)}$$

$$= \$9{,}857{,}272$$

$$P = P_0 = \frac{F}{1 + r\left(\frac{d}{365}\right)}$$

P = price
F = face value
r = required yield
d = remaining term to maturity

- **P and r are inversely related** (interest rates are always inversely related to price)
  - If required yield (r) increases, then the price (P) decreases (to make bond more attractive)
  - If required yield (r) decreases, then the price (P) increases