HM321 Engineering Economics
Fall 2024 – Lecture 2

Instructor: Dr. Ali Ahmad

Bring Calculator Always

- Always bring your calculator with you in lectures
- Without practice you will not be able to do the calculations in your exams

For Record

- Scheduled lecture on Friday, 18 October, 2024, did not take place due to announcement by Government and subsequent notice by UMT

Time Value of Money (TVM)

- The change in the amount of money over a given time period is called the time value of money
- $100 today is worth more than $100 one year from today

TVM is the most important concept in engineering economy

Interest

- Interest – the manifestation of the time value of money
  - Fee that one pays to use someone else's money
  - Interest is the difference between an ending amount of money and a beginning amount of money

Interest = end amount – original amount

Interest Rate

- Interest rate – Interest paid over a time period expressed as a percentage of principal

$$Interest\ rate(\%) = \frac{interest\ accrued\ per\ time\ unit}{principal} \times 100\%$$

Rate of Return (ROR)

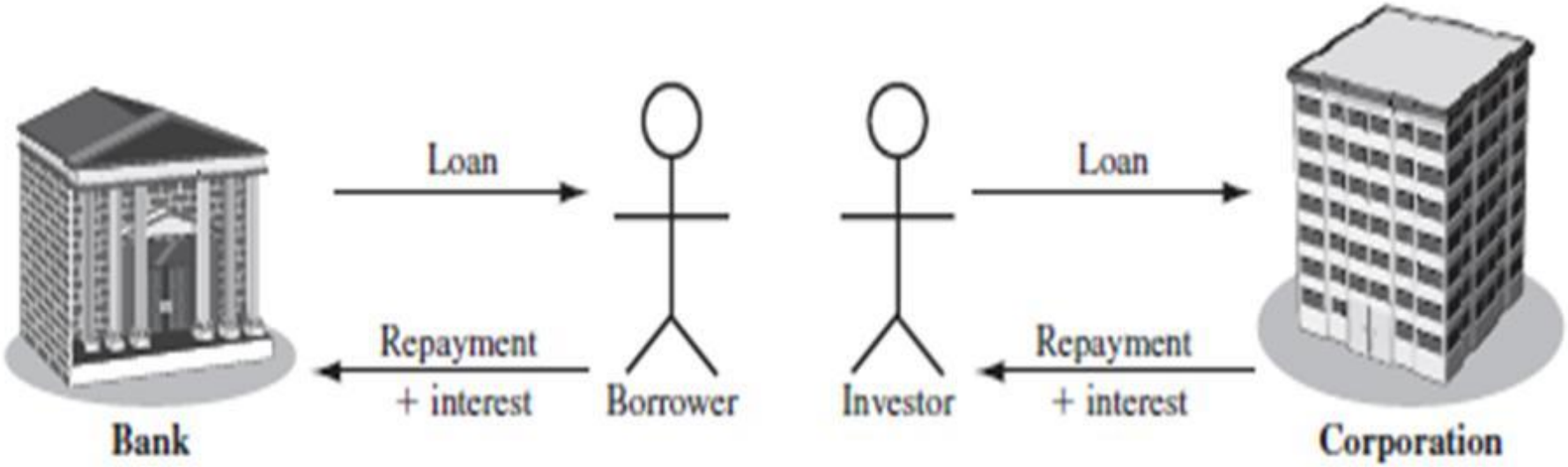
- Interest earned over a period of time is expressed as a percentage of the original amount (principal)

$$\text{Rate of return (\%)} = \frac{\text{interest accrued per time unit}}{\text{original amount}} \times 100\%$$

- Borrower's perspective – interest rate paid
- Lender's or investor's perspective – rate of return earned

Interest paid

Interest earned

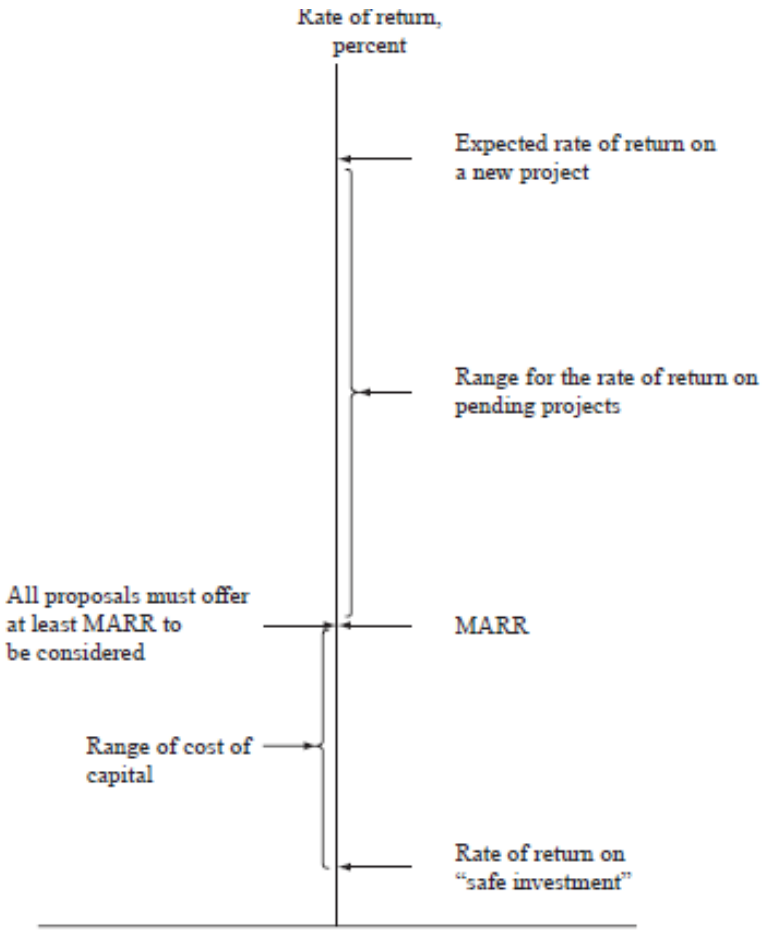


Interest rate

Rate of return

Minimum Attractive Rate of Return

- MARR is a reasonable rate of return (percent) established for evaluating and selecting alternatives
- An investment is justified economically if it is expected to return at least the MARR



MARR Characteristics

- MARR is established by the financial managers of the firm
- MARR is fundamentally connected to the cost of capital
- Both types of capital financing are used to determine the weighted average cost of capital (WACC) and the MARR
- MARR usually considers the risk inherent to a project

Types of Financing

- Equity Financing – Funds either from retained earnings, new stock issues, or owner's infusion of money
- Debt Financing – Borrowed funds from outside sources – loans, bonds, mortgages, venture capital pools, etc. Interest is paid to the lender on these funds
- For an economically justified project

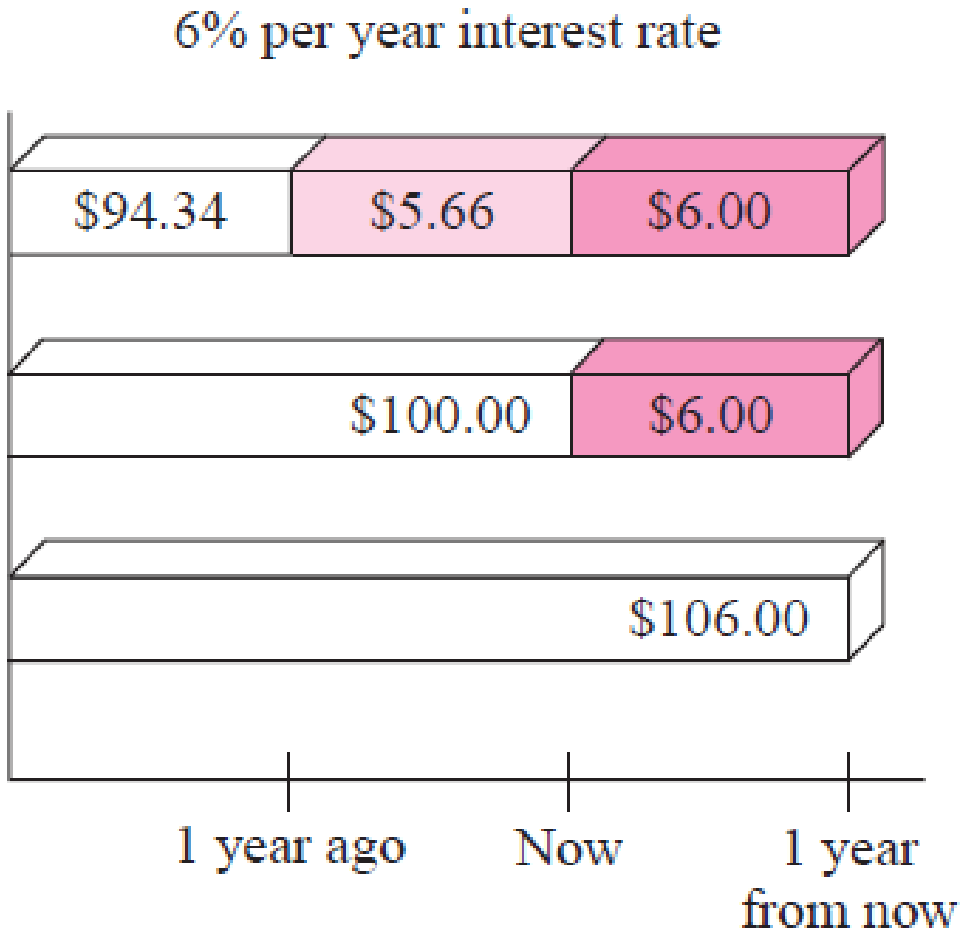
$$ROR \geq MARR > WACC$$

Economic Equivalence

- Definition: Combination of interest rate (rate of return) and time value of money to determine different amounts of money at different points in time that are economically equivalent

- How it works: Use rate *i* and time *t* in upcoming relations to move money (values of P, F and A) between time points *t* = 0, 1, …, n to make them equivalent (not equal) at the rate *i*

FIGURE 1.2
Equivalence of three amounts at a 6% per year interest rate.



Commonly Used Symbols

- t = time, usually in periods such as years or months
- P = value or amount of money at a time t designated as present or time 0
- F = value or amount of money at some future time, such as at t = n periods in the future
- A = series of consecutive, equal, end-of-period amounts of money
- n = number of interest periods; years, months
- i = interest rate or rate of return per time period; percent per year or month

Cash Flow Terms

- **Cash Inflows** – Revenues (R), receipts, incomes, savings generated by projects and activities that flow in. Plus sign used
- **Cash Outflows** – Disbursements (D), costs, expenses, taxes caused by projects and activities that flow out. Minus sign used
- **Net Cash Flow** (NCF) for each time period:

  NCF = cash inflows – cash outflows = R – D
- End-of-period assumption:

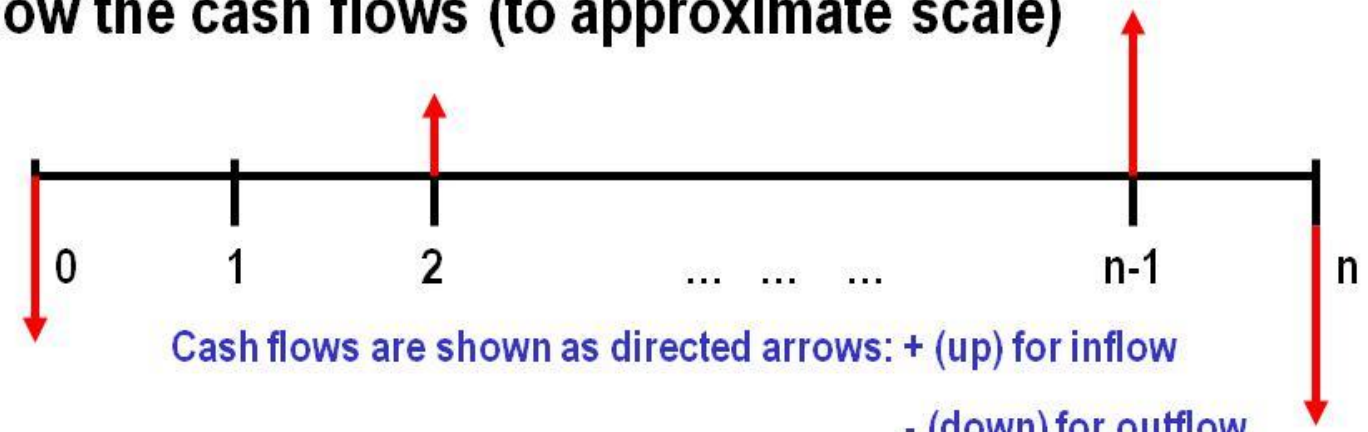
  Funds flow at the end of a given interest period

Cash Flow Diagrams

Draw a time line

Always assume end-of-period cash flows

Show the cash flows (to approximate scale)



Cash flows are shown as directed arrows: + (up) for inflow

- (down) for outflow

Simple and Compound Interest

- Simple interest is calculated using principal only
- Interest = (principal)(number of periods)(interest rate)

$$I = Pni$$

- Example:
- $100,000 lent for 3 years at simple i = 10% per year. What is repayment after 3 years?
- Interest = 100,000(3)(0.10) = $30,000
- Total due = 100,000 + 30,000 = $130,000

Simple and Compound Interest - 2

- Compound Interest
- At the end of each interest period:
  - Interest for that period is calculated on the accumulated amount at the beginning of that period
  - The calculated interest is added to (compounded) the accumulated amount at the beginning
  - This becomes the accumulated amount at the beginning of the next interest period

Compound Interest Example

- **Example:** $100,000 lent for 3 years at i = 10% per year compounded. What is repayment after 3 years?
- Interest, year 1: I1 = 100,000(0.10) = $10,000
- Total due, year 1: T1 = 100,000 + 10,000 = $110,000

- Interest, year 2: I2 = 110,000(0.10) = $11,000
- Total due, year 2: T2 = 110,000 + 11,000 = $121,000

- Interest, year 3: I3 = 121,000(0.10) = $12,100
- Total due, year 3: T3 = 121,000 + 12,100 = $133,100

- Compounded: $133,100 Simple: $130,000

Formula for Compound Amount

- The following formula was derived in the class during lecture:

$$F = P(1+i)^n$$

- Where

  F = Future amount (compound amount)

  P = Principal amount

  i = Interest rate (in decimal)

  n = Number of interest periods

Reference

- Basics of Engineering Economy by Leland Blank and Anthony Tarquin, 2nd edition, McGraw-Hill