HM321 Engineering Economics
Fall 2024 – Lecture 8

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

Chapter 3

NOMINAL AND EFFECTIVE INTEREST RATES

Interest Rate Statement

- The terms 'nominal' and 'effective' enter into consideration when the interest period is less than one year
  - That is, when interest is compounded more than once in one year. For example:
    - 12 times for monthly compounding
    - 4 times for quarterly compounding
- Nominal means what is specified
- Effective means what is used in calculations

Interest Rate Statement - 2

- Specified: <u>1% per month</u>
  - Compounding takes place every month
  - Symbol n in interest formulas <u>must be in months</u>
- Specified: <u>10% per year compounded monthly</u>
  - In one year compounding takes place 12 times
  - Therefore effective interest rate per year will be more than 10% (due to 12 compoundings)
- <u>Interest period (t)</u> is the time period over which the interest rate is specified
  - That is, the time period after "per"

Compounding Period and Compounding Frequency

- Compounding period (CP) is the shortest period over which interest is compounded

- Compounding frequency (m) is number of times compounding occurs within the specified interest period (t). For example
  - 8% per year compounding monthly (m = 12)
  - 3% per quarter compounded monthly (m = 3)
  - 8% per year compounded quarterly (m = 4)

Nominal Interest Rate (r)

- Nominal interest rate for any period longer than compounding period is calculated by

  r = interest rate per compounding period x number of compounding periods

- Nominal interest rate (r) <u>ignores compounding</u>

- For example:
  – Specified: 1% per month
  – Nominal interest rate r is 12% per year compounded monthly

Effective Interest Rate (i)

- Effective interest rate <u>takes compounding into account</u>

- For example:
    - Specified: 1% per month
    - Effective interest rate i is 12.6825% per year

- In all interest formulas effective interest rate is used

Interpretation of Interest Rate Statements (Table 3.1)

TABLE 3.1 Various Interest Statements and Their Interpretations

(1) Interest Rate Statement	(2) Interpretation	(3) Comment
$i = 12\%$ per year	$i = $ *effective* 12% per year compounded yearly	When no compounding period is given, interest rate is an effective rate, with compounding period assumed to be equal to stated time period.
$i = 1\%$ per month	$i = $ *effective* 1% per month compounded monthly	
$i = 3\frac{1}{2}\%$ per quarter	$i = $ *effective* 3½% per quarter compounded quarterly	

Interpretation of Interest Rate Statements (Table 3.1) - 2

TABLE 3.1 Various Interest Statements and Their Interpretations

(1) Interest Rate Statement	(2) Interpretation	(3) Comment
i = 8% per year, compounded monthly	i = *nominal* 8% per year compounded monthly	When compounding period is given without stating whether the interest rate is nominal or effective, it is assumed to be nominal. Compounding period is as stated.
i = 4% per quarter compounded monthly	i = *nominal* 4% per quarter compounded monthly	
i = 14% per year compounded semiannually	i = *nominal* 14% per year compounded semiannually	

Interpretation of Interest Rate Statements (Table 3.1) -3

TABLE 3.1   **Various Interest Statements and Their Interpretations**

(1) Interest Rate Statement	(2) Interpretation	(3) Comment
i = effective 10% per year compounded monthly	i = *effective* 10% per year compounded monthly	If interest rate is stated as an effective rate, then it is an effective rate. If compounding period is not given, compounding period is assumed to coincide with stated time period.
i = effective 6% per quarter	i = *effective* 6% per quarter compounded quarterly	
i = effective 1% per month compounded daily	i = *effective* 1% per month compounded daily	

Interest Rate Statement Examples (Table 3.2)

TABLE 3.2 Specific Examples of Interest Statements and Interpretations

(1) Interest Rate Statement	(2) Nominal or Effective Interest	(3) Compounding Period
15% per year compounded monthly	Nominal	Monthly
15% per year	Effective	Yearly
Effective 15% per year compounded monthly	Effective	Monthly
20% per year compounded quarterly	Nominal	Quarterly
Nominal 2% per month compounded weekly	Nominal	Weekly
2% per month	Effective	Monthly
2% per month compounded monthly	Effective	Monthly
Effective 6% per quarter	Effective	Quarterly
Effective 2% per month compounded daily	Effective	Daily
1% per week compounded continuously	Nominal	Continuously

Formula for Effective Interest Rate per Period t

- Effective interest rate i for a period t that is integer multiple of compounding period CP can be calculated:
  - CP = compounding period
  - t = m x CP (m is frequency of compounding in t)
  - r = nominal interest rate per t
  - i = effective interest rate per t

$$ i = (1 + \frac{r}{m})^m - 1 $$

Effective Interest Rate for Continuous Compounding

- Effective interest rate i for continuous compounding is given by:

$$i = e^r - 1$$

- where
  - r = nominal interest rate per t
  - i = effective interest rate per t
- Study Table 3.3 in Blank and Tarquin

Reference

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