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قسم التمويل والاستثمار

Course	**Financial Mathematics**
Unit course	**FIN 118**
Number Unit	**8**
Unit Subject	**Time Value of Money** **Simple Interest**

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we will see in this unit

- ✓The relationship between time and money.
- ✓ The simple interest rate and the interest amount
- ✓ The present value of one future cash flow
- ✓ The future value of an amount borrowed or invested.
- ✓ The relationship between Real Interest Rate, Nominal Interest Rate and Inflation.

LEARNING OUTCOMES

At the end of this chapter, you should be able to:

1. Understand simple interest including accumulating, discounting and making comparisons using the effective interest rate.

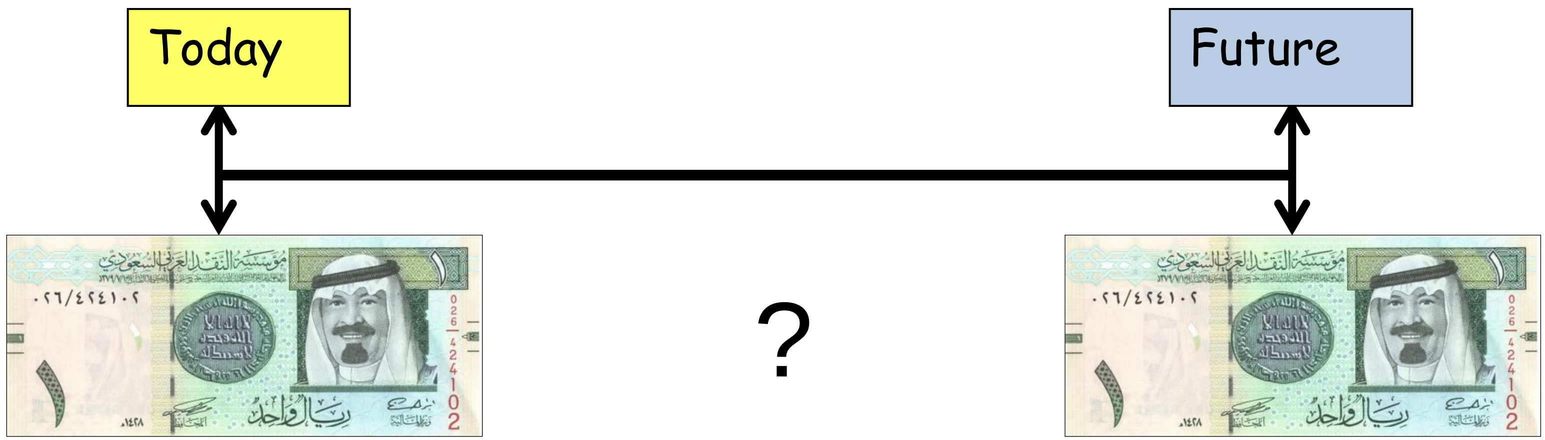
2. Identify variables fundamental to solving interest problems.

3. Solve problems including future and present value.

4. Distinguish between nominal and effective interest rates.

Time value of Money

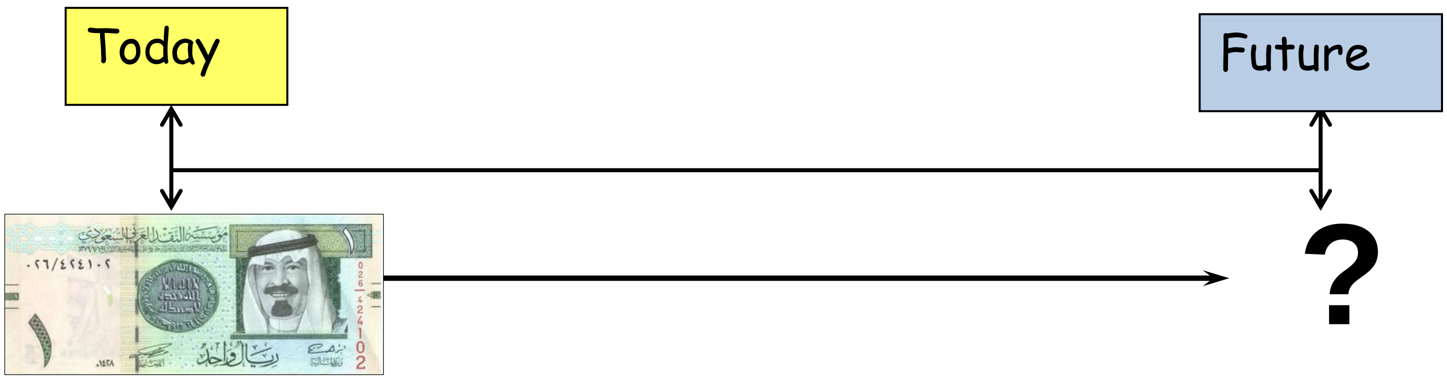
- The time value of money is the relationship between time and money.
- Receiving 1 SAR today is worth more than 1 SAR in the future. This is due to opportunity costs.
- TIME allows you the opportunity to postpone consumption and earn INTEREST



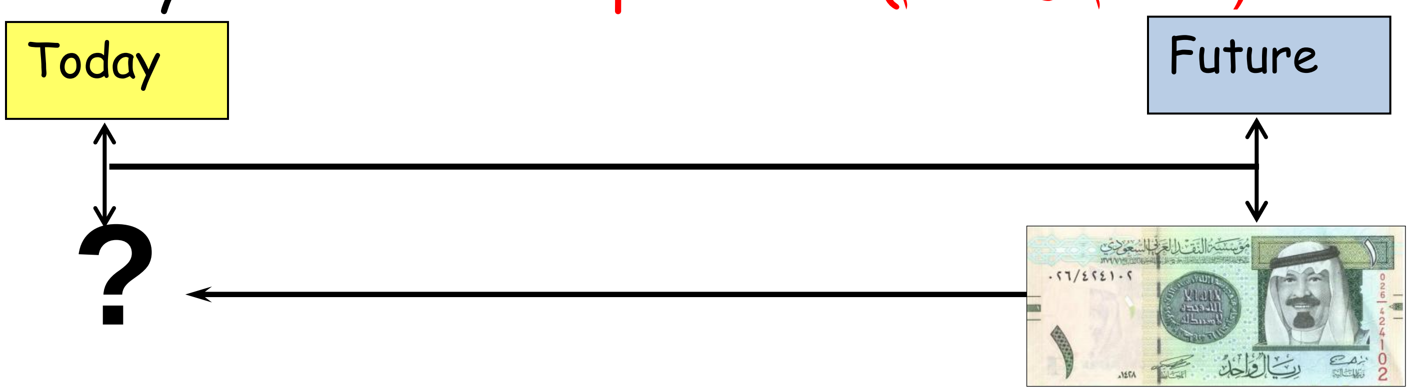
Time value of Money

If we can measure this opportunity cost, we can:

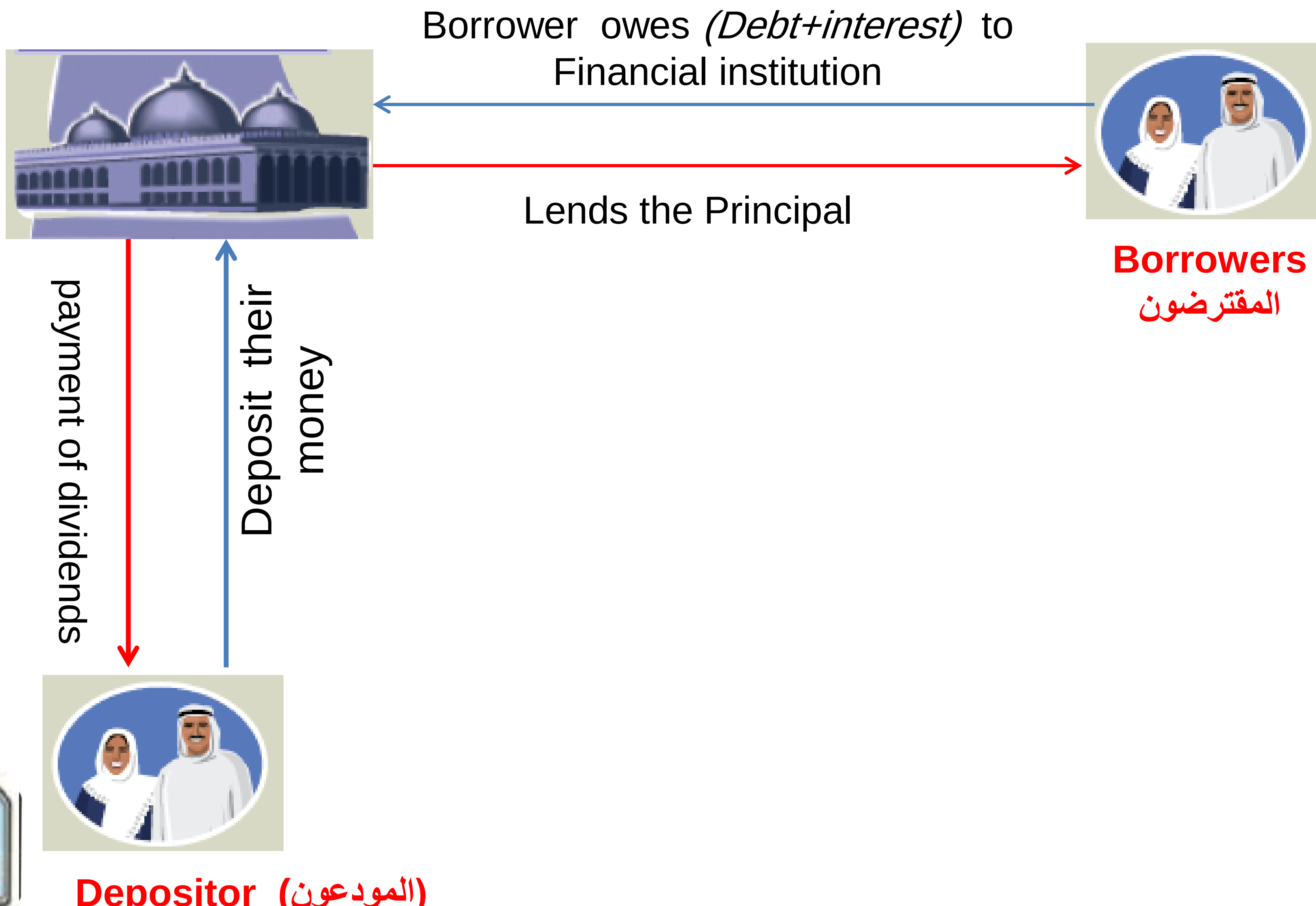
- Translate 1 SAR today into its equivalent in the future : operation of capitalization(الرسملة)



- Translate 1 SAR in the future into its equivalent today: Discounted operation (الخصم أو الحسم)



Time value of Money



Time value of Money Fundamental Concepts

- Principal: The amount borrowed or invested.
- Interest rate: A percentage of the outstanding principle.
- Time: The number of years or fractional portion of a year that principal is outstanding.
- A present value is the discounted value of one or more future cash flows.
- A future value is the compounded value of a present value.
- The discount factor is the present value of one riyal invested in the future.
- The compounding factor is the future value of one riyal invested today.

Time value of Money

Loan Types

- **Short term loans (less than 1 year)**
  - Simple Interest Method
    - Interest is paid on the principal on the date due
  - Bank Discount Method
    - Interest is paid on the date of issue using a discount rate
- **Long term loans (more than 1 year)**
  - Compound Interest Method
    - Interest is added periodically to the principal. Interest is paid on the accumulated value

The Simple Interest

Definition1: An interest amount in each period is computed based on a principal sum in the period.

Interest = Principal × Interest Rate × number of periods

$$I = PV \times i \times n$$

Definition2: The future value is the sum of present value and the interest amount.

Future Value = Present Value + Interest

$$FV_n = PV + I$$

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

Formulas of simple interest method

$$I = PV \times i \times n$$

$$i = \frac{I}{PV \times n}$$

$$n = \frac{I}{PV \times i}$$

$$PV = \frac{I}{i \times n}$$

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

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

The Simple Interest

More Examples

Example1: Interest

How much money would you pay in interest if you borrowed $1600 for 1 year at 16% simple interest per annum?

Solution:

Convert the percent to a decimal: 16% = 0.16

$$I = PV \times i \times n$$

$$I = \$1600 \times 0.16 \times 1$$

$$I = \$256$$

The Simple Interest

More Examples

Example2: Interest

How much money would you pay in interest if you borrowed $16000 for 6 months at 12% simple interest per annum?

Solution:

Convert the percent to a decimal: 12% = 0.12

Convert the period to a year n = 6 months = 6/12 = 0.5 year (1 year contains 12 months)

$I = PV \times i \times n$

$I = \$16000 \times 0.12 \times 0.5$

$I = \$960$

The Simple Interest

More Examples

Example3: Interest

How much money would you pay in interest if you borrowed $16000 for 9 months at 3% quarterly simple interest?

Solution:

Convert the percent to a decimal: 3% = 0.03

Convert the period to quarters n= 9 months = 9/3 = 3 quarters (1 Quarter contains 3 months)

$$I = PV \times i \times n$$

$$I = \$16000 \times 0.03 \times 3$$

$$I = \$1440$$

The Simple Interest

More Examples

Example4: Interest and Future Value

You take a 40000 SAR loan on 9/5/2012. Date due is 1/10/2013. Annual simple interest rate is 12%. Calculate:

a) The interest

b) The amount that he must pay on the date due?

Solution:

a) From 9/5/2012 to 1/10/2013, we have 127 days.

Convert the period to years

$$n = 127 \text{ days} = (127/365) \text{ year}$$

$$I = 40000 \times 0.12 \times (127/365) = 1670.13 \text{ SAR}$$

b) $FV = PV + I = 40000 + 1670.13 = 41670.13 \text{ SAR}$

The Simple Interest

More Examples

Example5: Present Value

When invested at an annual interest rate of 6% an account earned $180 of simple interest in one year. How much money was originally invested in account?

Solution:

Convert the percent to a decimal: 6% = 0.06

$$I = PV \times i \times n \Rightarrow PV = \frac{I}{i \times n}$$

$$PV = \frac{180}{0.06 \times 1} = \$3000$$

The Simple Interest

More Examples

Example6: Interest rate

A savings account is set up, so that the simple interest earned on the investment is moved into a separate account at the end of each year. If an investment of $7000 accumulate $910 of interest in the account after 1 year, what was the annual simple interest rate on the savings account?

Solution: (13%)

The Simple Interest

More Examples

Example7: Interest rate

Badr bought a 6-month $1900 certificate of deposit. At the end of 6 months, he received a $209 simple interest. What rate of interest did the certificate pay?

!!! The certificate of deposit (CD) are different from savings accounts in that the CD has a specific, fixed term (often monthly, three months, six months, or one to five years), and, usually, a fixed interest rate.

Solution: (11%)

The Simple Interest

More Examples

Example8: Future Value

An investment earns 4.5% simple interest in one year. If the money is withdrawn before the year is up, the interest is prorated so that a proportional amount of the interest is paid out. If $2400 is invested, what is the total amount that can be withdrawn when the account is closed out after 2 months?

Solution:

Convert the percent to a decimal: 4.5% = 0.045

Convert the period to years: 2 months = 2/12 years

$$FV_2 = PV \times [1 + i \times n] \Rightarrow FV_2 = 2400 \times \left[1 + 0.045 \times \frac{2}{12}\right]$$

$$FV_2 = \$2418$$

Nominal Interest Rates vs. Real Interest Rates

State1: Suppose we buy a 1 year bond for face value that pays 6% at the end of the year. We pay $100 at the beginning of the year and get $106 at the end of the year. Thus the bond pays an interest rate of 6%. This 6% is the nominal interest rate, as we have not accounted for inflation. Whenever people speak of the interest rate they're talking about the nominal interest rate, unless they state otherwise.

Nominal Interest Rates vs. Real Interest Rates

State2: Now suppose the inflation rate is 3% for that year. We can buy a basket of goods today and it will cost $100, or we can buy that basket next year and it will cost $103. If we buy the bond with a 6% nominal interest rate for $100, sell it after a year and get $106, buy a basket of goods for $103, we will have $3 left over. So after factoring in inflation, our $100 bond will earn us $3 in income; a real interest rate of 3%. The relationship between the nominal interest rate, inflation, and the real interest rate is described by the Fisher Equation:

Real Interest Rate = Nominal Interest Rate - Inflation

It's time to review

Simple Interest	Compound interest
$I = PV \times i \times n$	see Unit 9
$FV_n = PV + I$	see Unit 9
$FV_n = PV(1 + i \times n)$	see Unit 9
More than one compounding periods per year	
See Unit 9	

Real Interest Rate = Nominal Interest Rate - Inflation

we will see in the next unit

- ✓ The compound interest rate and the interest amount
- ✓ How to Calculate the future value of a single sum of money invested today for several periods.
- ✓ How to Calculate the interest rate or the number of periods or the principal that achieve a fixed future value.