Thammasat University
Faculty of Economics
Bachelor of Economics (International Program)

AC201
Fundamental Accounting

Semester 1/2011

Course Materials

Topic:

Supplement to Chapter 09-10
Time Value of Money

Session:

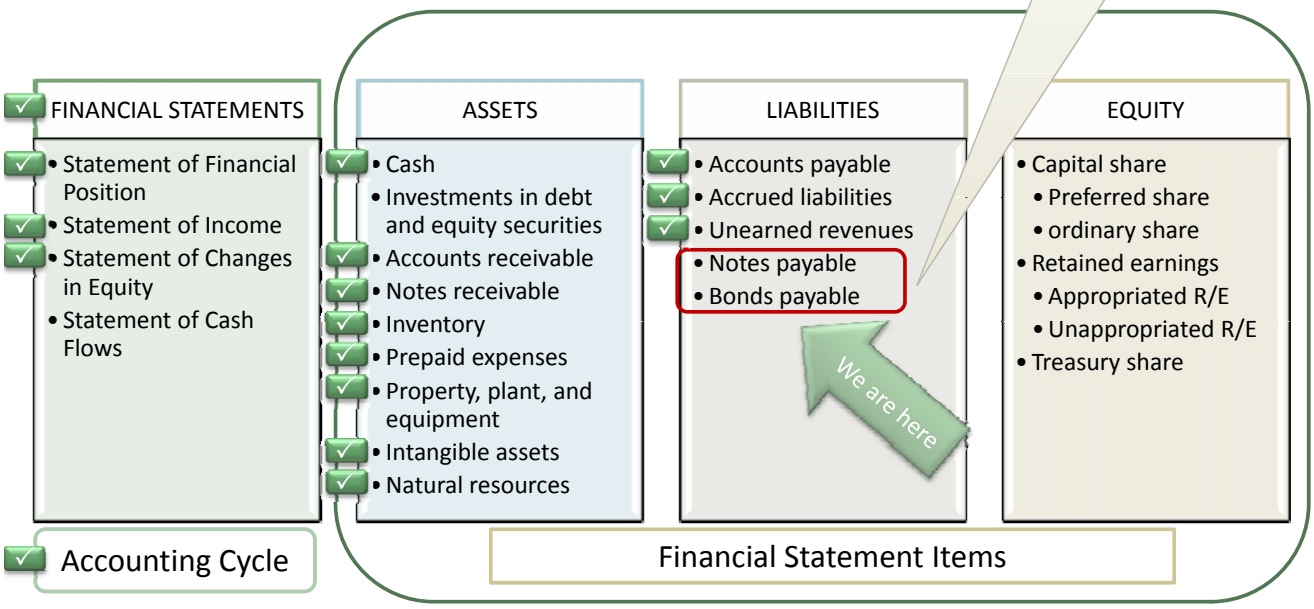
Session #9

Instructor:

Assistant Professor Dr. Orapan Yolrabil

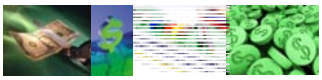
Time Value of Money Concept:
Application of TVM in determining bond issue price

I/S: Interest expense



FINANCIAL STATEMENT ANALYSIS

AC201 Fundamental Accounting



TIME VALUE OF MONEY: PRESENT AND FUTURE VALUES

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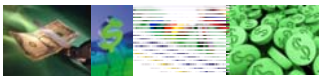
Time Value of Money

- ***Time value of money concept*** **refers to costs or benefits derived from holding or not holding money over time.**
  - ***Interest*** is the cost of using money for a specific period.
    - ***Simple interest*** is the interest cost for one or more periods when the principal sum – the amount on which interest is computed – stays the same from period to period.
    - ***Compound interest*** is the interest cost for two or more periods when after each period, the interest earned in that period is added to the amount on which interest is computed in future periods.

"Time is money"



Simple Interest

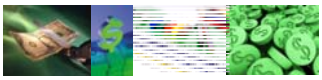
- **Example of simple interest:**
  - The Company accepts an 8 percent, 30,000 Baht note due in 90 days. How much will the Company receive at that time?
    - The interest is calculated as follows:
      - Interest = Principal x Rate x Time
        = 30,000 x 8/100 x 90/365
        = 591.78 Baht
    - Therefore, the total that the Company will receive is 30,591 Baht, calculated as follows:
      - Total = Principal + Interest
        = 30,000 + 591.78
        = 30,591.78 Baht

Compound Interest

- **Example of compound interest:**
  - The Company deposits 5,000 Baht in an account that pays 6 percent interest. It expects to leave the principal and accumulated interest in the account for three years. How much will the account total at the end of three years?
    - Assume that the interest is paid at the end of the year and is added to the principal at that time, and that this total in turn earns interest.
    - The amount at the end of three years is computed as follows:

(1) Year	(2) Principal Amount at Beginning of Year	(3) Annual Amount of Interest (Col. 2 x 6%)	(4) Accumulated Amount at End of Year (Col. 2 + Col. 3)
1	5,000.00	300.00	5,300.00
2	5,300.00	318.00	5,618.00
3	5,618.00	337.08	5,955.08

    - At the end of three years, the Company will have 5,955.08 Baht in its account.

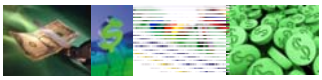


Future Value

- **Future value is the amount an investment will be worth at a future date if invested at compound interest.**
  - An example of question asking about future value is *"what is the future value of a single sum (5,000 Baht) at compound interest (6 percent) for three years?"*

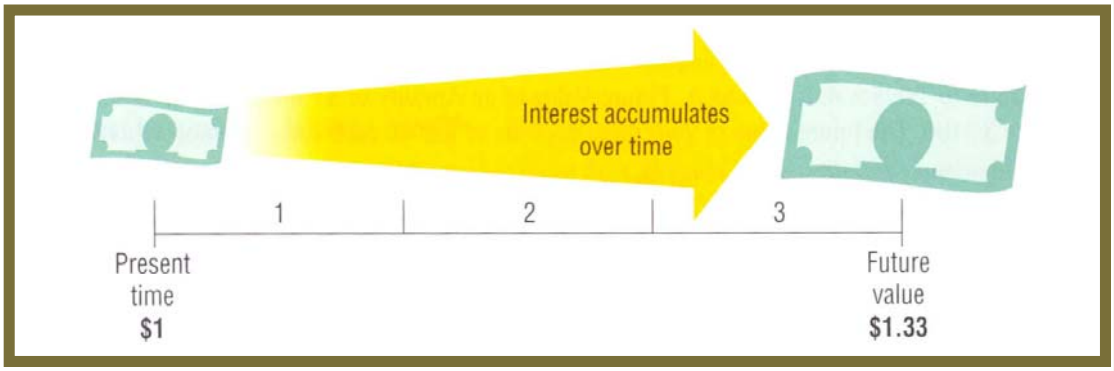
Future Value of a Single Sum (FV)

- **In future value of a single amount problems, you will be asked to calculate how much money you will have in the future as the result of investing a certain amount in the present.**
  - If you were to receive a gift of 10,000 Baht, for instance, you might decide to put it in a savings account and use the money as a down payment on a house after you graduate. The future value computation would tell you how much money will be available when you graduate.
    - To solve a future value problem, you need to know three items:
      - Amount to be invested
      - Interest rate (i) the amount will earn
      - Number of periods (n) in which the amount will earn interest



Future Value of a Single Sum (Cont.)

- **Since the future value concept is based on compound interest, the amount of interest for each period is calculated by multiplying the principal plus any interest not paid out in prior periods.**
  - Graphically, the calculation of the future value of 1 Baht for three periods and an interest rate of 10 percent may be represented as follows:

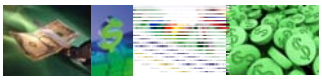


Future Value of a Single Sum (Cont.)

- **Example of Future Value of a Single Sum:**
  - Assume that on January 1, 2009, you deposit 1,000 Baht in a savings account at 10 percent annual interest, compounded annually.
    - At the end of three years, the 1,000 Baht will have increased to 1,331 Baht as follows:

(1) Year	(2) Principal Amount at Beginning of Year	(3) Annual Amount of Interest (Col. 2 x 10%)	(4) Accumulated Amount at End of Year (Col. 2 + Col. 3)
1	1,000.00	100.00	1,100.00
2	1,100.00	110.00	1,210.00
3	1,210.00	121.00	1,331.00

    - FV Table:
      - FV = PV x FV Factor
        1,331 = 1,000 x 1.3310
    - Financial calculator:
      - PV = 1,000, I = 10%, n = 3 → FV = 1,331

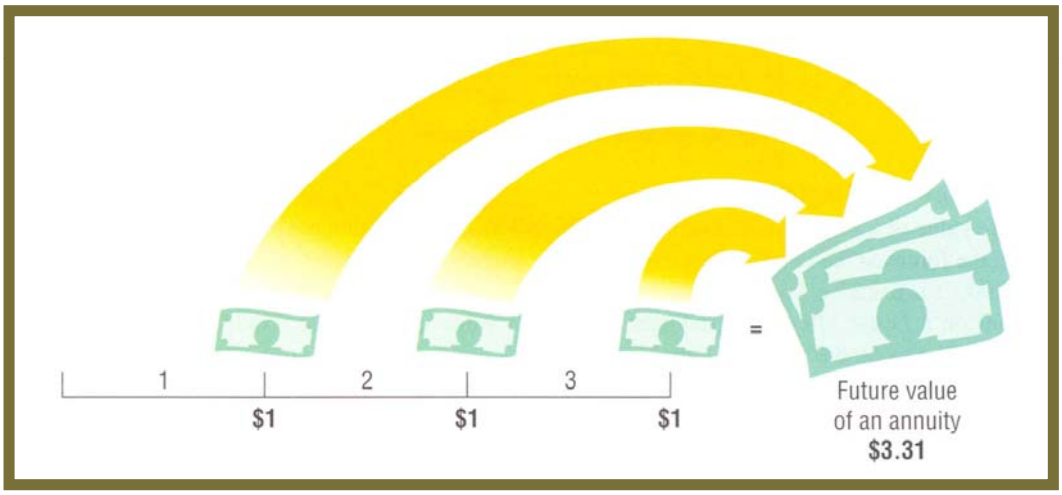


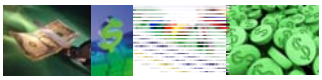
Future Value of An Annuity (FVA)

- **Ordinary annuity is a series of equal payments made at the end of equal intervals of time, with compound interest of these payments.**
  - The future value of an annuity includes compound interest on each payment from the date of payment to the end of the term of the annuity. Each new payment accumulates less interest than prior payments, only because the number of periods remaining in which to accumulate interest decreases.

Future Value of An Annuity (Cont.)

- The future value of annuity of 1 Baht for three periods at 10 percent may be represented graphically as:





Future Value of An Annuity (Cont.)

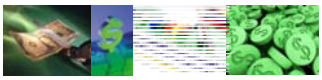
- **Example of Future Value of an Annuity:**
  - Assume that each year for three years, you deposit 1,000 Baht cash in a savings account at 10 percent interest per year. You make the first 1,000 Baht deposit on December 31, 2009, the second one on December 31, 2010, and the third and last one on December 31, 2011.
    - The first 1,000 Baht deposit earns compound interest for two years (for a total principal and interest of 1,210 Baht); the second deposit earns interest for one year (for a total principal and interest of 1,100 Baht). The third deposit earns no interest because it was made on the day that the balance is computed.
    - Thus, the total amount in the savings account at the end of three years is 3,310 Baht (1,210 + 1,100 + 1,000).

Future Value of An Annuity (Cont.)

- Compound interest calculation:

(1) Year	(2) Principal Amount at Beginning of Year	(3) Annual Amount of Interest (Col. 2 x 10%)	(4) Periodic Payment	(5) Total Amount Accumulated at the End of the Year (Col. 2 + Col.3 + Col. 4)
1	-	-	1,000.00	1,000.00
2	1,000.00	100.00	1,000.00	2,100.00
3	2,100.00	210.00	1,000.00	3,310.00

- FV Table:
  - FV = PMT x FVA Factor
    3,310 = 1,000 x 3.3100
- Financial calculator:
  - PMT = 1,000, I = 10%, n = 3 → FV = 3,310

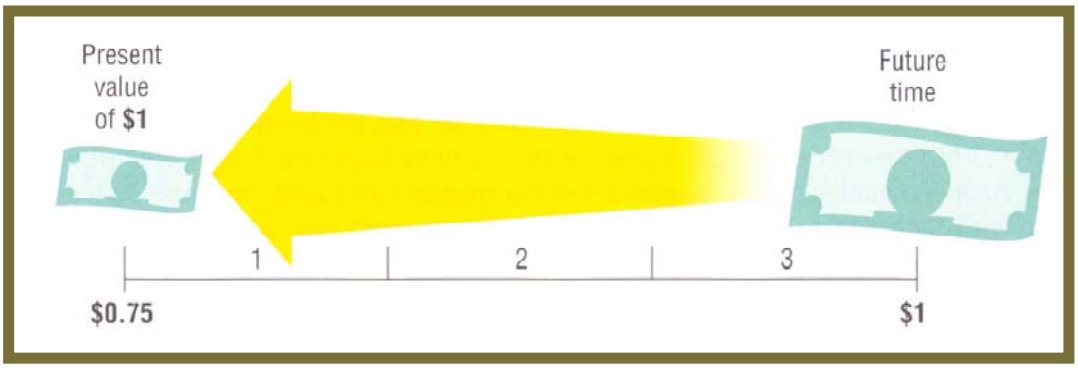


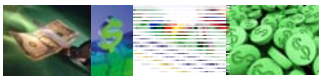
Present Value

- **Present value is the amount that must be invested today at a given rate of interest to produce a given future value.**
  - The amount to be received in the future (future value) is not worth as much as today as an amount received today (present value).
  - Example:
    - The Company needs 1,000 Baht one year from now. How much does she have to invest today to achieve that goal if the interest rate is 5 percent?
      - Recall: $PV \times (1 + i)^n = FV$
      - $PV = FV / (1 + i)^n$
      - Thus, $PV = 1,000 / (1.05)^1$
      - $PV = 952.38$ Baht

Present Value of a Single Sum (PV)

- **Present value of a single sum**
  - The present value of a single amount is the worth to you today of receiving that amount some time in the future.
  - Graphically, the present value of 1 Baht due at the end of the third period with an interest rate of 10 percent can be represented as follows:





Present Value of a Single Sum (Cont.)

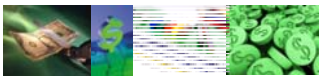
- **Example of Present Value of a Single Sum**
  - Suppose the Company wants to be sure of having 4,000 Baht at the end of three years. How much must it invest today in a 5 percent savings account to achieve this goal?
    - The calculation is presented as follows:

(1) Year	(2) Amount at the End of Year	÷	(3) Divided by (1 + i)	(4) Present Value at the Beginning of Year (Col. 2 ÷ Col. 3)
1	4,000.00	÷	1.05	3,809.52
2	3,809.52	÷	1.05	3,628.12
3	3,628.12	÷	1.05	3,455.35

    - The Company must invest 3,455.35 Baht $(4,000/(1.05)^3)$ today to achieve a value of 4,000 Baht in three years.

Present Value of a Single Sum (Cont.)

- PV Table:
  - PV = FV x PV factor
    3,455.35 = 4,000 x 0.8640
- Financial calculator:
  - FV = 4,000, I = 10%, n = 3 → PV = 3,455.35

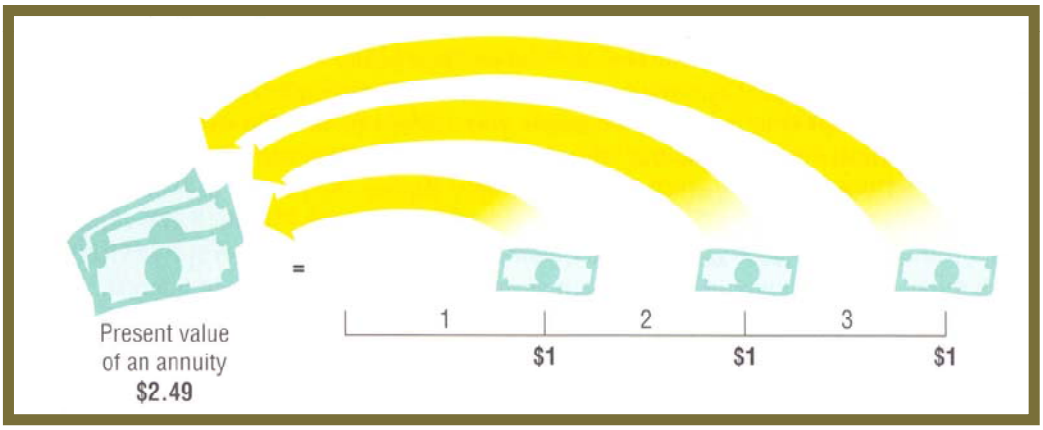


Present Value of an Annuity (PVA)

- **Present value of an ordinary annuity**
  - Recall that an annuity is a series of consecutive payments characterized by
    - An equal dollar amount each interest period.
    - Interest periods of equal length (year, half a year, quarter, or month)
    - An equal interest rate each interest period.
  - The present value of an annuity is the value now of a series of equal amounts to be received (or paid out) for some specified number of periods in the future. It is computed by discounting each of the equal periodic amounts.

Present Value of an Annuity (Cont.)

- The present value of an annuity of 1 Baht for three periods at 10 percent interest may be represented graphically as follows:



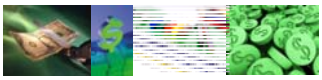
Present Value of an Annuity (Cont.)

- **Example of Present Value of an Annuity:**
  - The Company has sold a piece of property and is to receive 15,000 Baht in three equal annual payments of 5,000 Baht beginning one year from today. What is the present value of this sale if the current interest rate is 5 percent?
    - PV Table:

Future Receipt (Annuity)				Present		Present
Year 1	Year 2	Year 3		Value Factor		Value
5,000.00			x	0.952	=	฿4,760.00
	5,000.00		x	0.907	=	฿4,535.00
		5,000.00	x	0.864	=	฿4,320.00
						฿13,615.00

Present Value of an Annuity (Cont.)

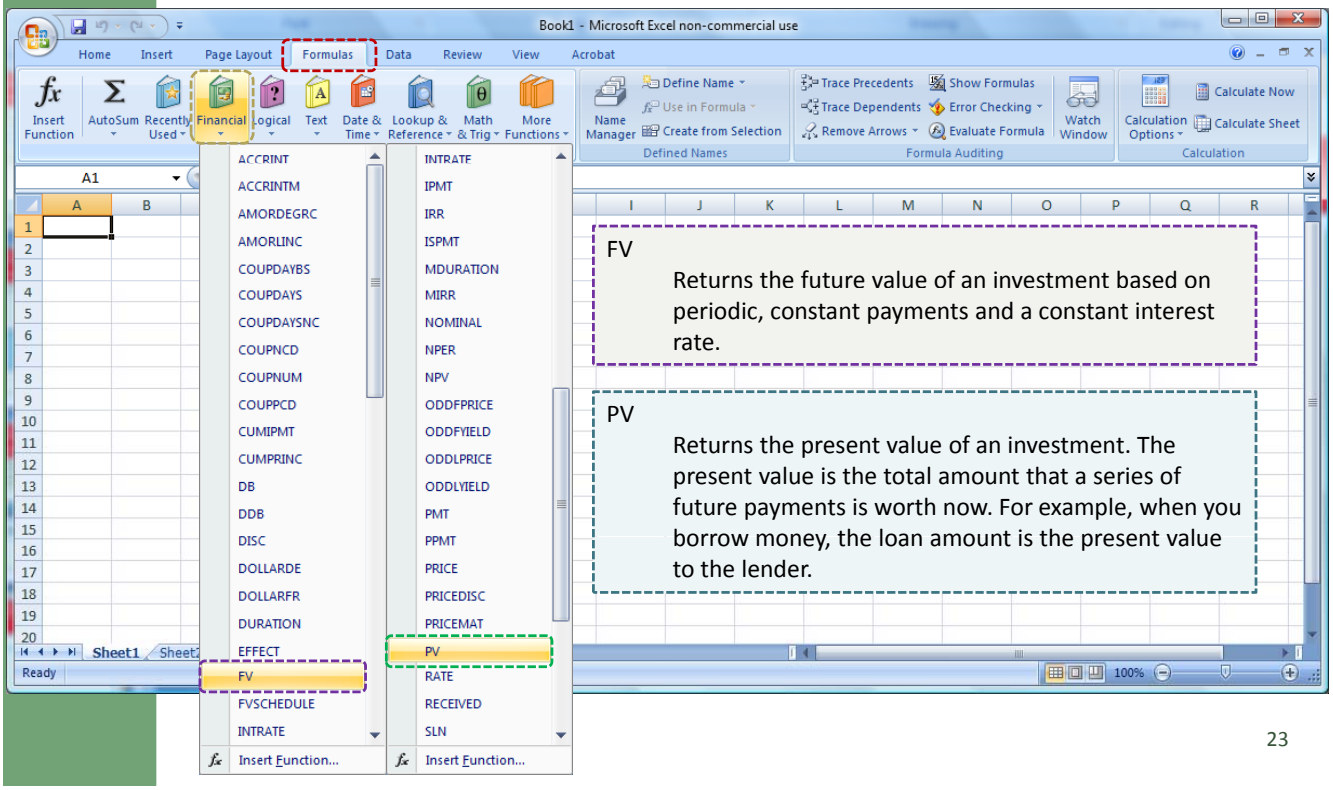
- Or PVA Table:
  - PV = PMT x PVA Factor
  - 13,615 = 5,000 x 2.723
- Financial calculator:
  - PMT = 5,000, I = 5%, n = 3 → PV = 13,615



Using Formulas to Determine FV and PV

- **Future Value of a Single Sum**
  - $FV = PV \times (1 + i)^n$
- **Future Value of an Annuity**
  - $FVA = PMT [((1 + i)^n - 1) / i]$
- **Present Value of a Single Sum**
  - $PV = FV / (1 + i)^n$
- **Present Value of an Annuity**
  - $PVA = PMT [(1 - (1 / (1 + i)^n)) / i]$

Using Excel to determine FV and PV



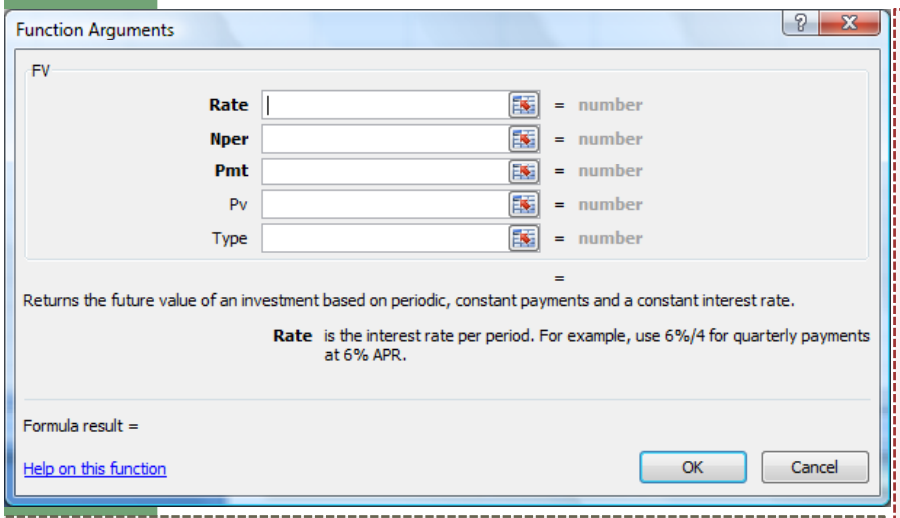
FV

Returns the future value of an investment based on periodic, constant payments and a constant interest rate.

PV

Returns the present value of an investment. The present value is the total amount that a series of future payments is worth now. For example, when you borrow money, the loan amount is the present value to the lender.

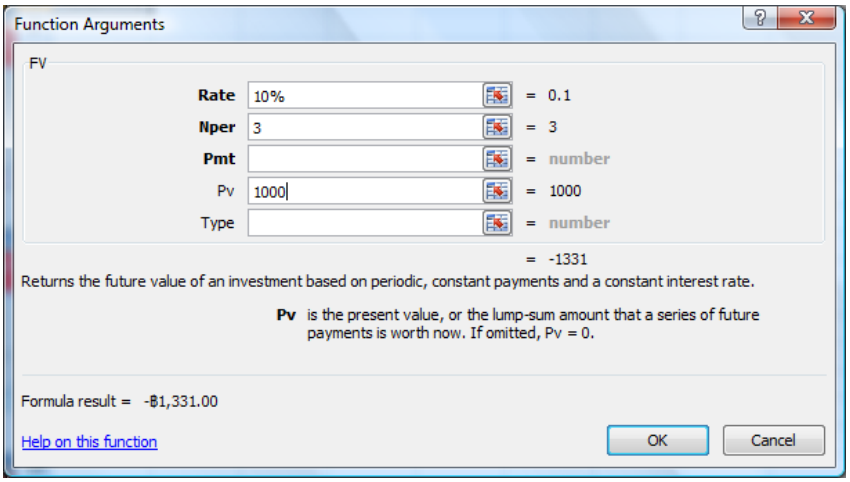
Future Value Calculation with Excel



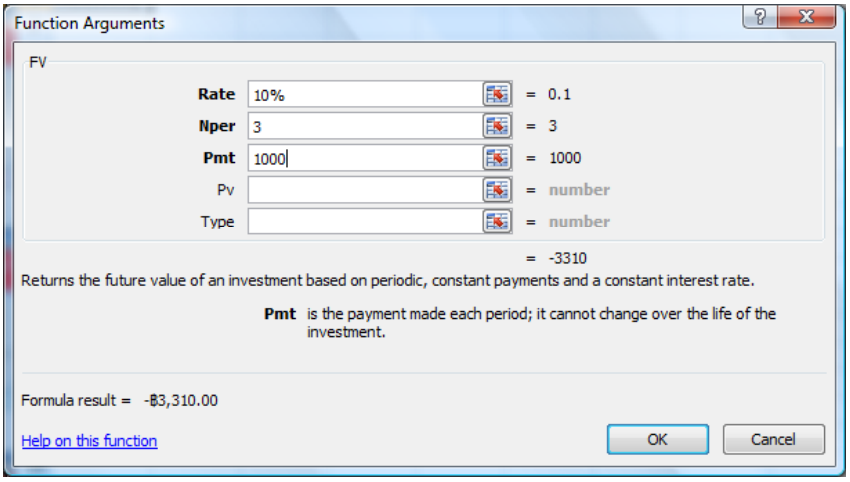
Syntax

FV(rate,nper,pmt,pv,type)

Rate is the interest rate per period.
Nper is the total number of payment periods in an annuity.
Pmt is the payment made each period; it cannot change over the life of the annuity. Typically, pmt contains principal and interest but no other fees or taxes. If pmt is omitted, you must include the pv argument.
Pv is the present value, or the lump-sum amount that a series of future payments is worth right now. If pv is omitted, it is assumed to be 0 (zero), and you must include the pmt argument.
Type is the number 0 or 1 and indicates when payments are due. If type is omitted, it is assumed to be 0.

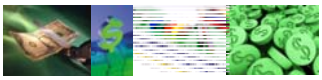


Future Value of a Single Sum

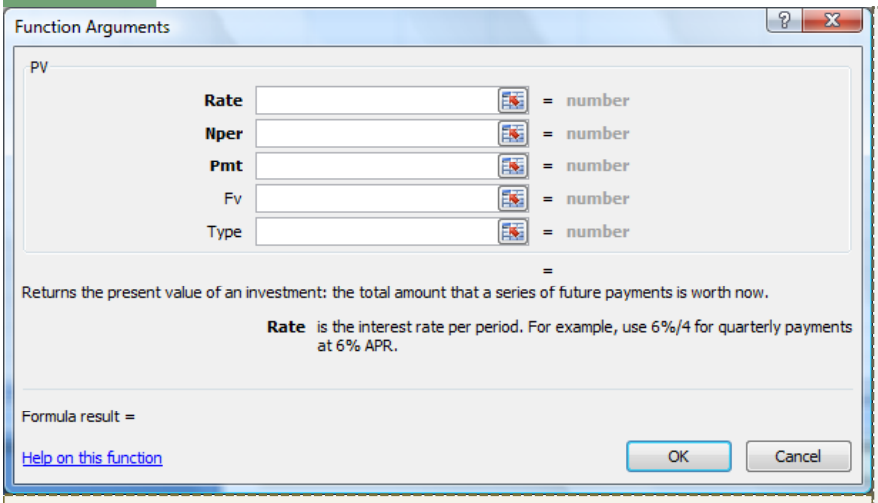


Future Value of an Annuity

AC201 Fundamental Accounting



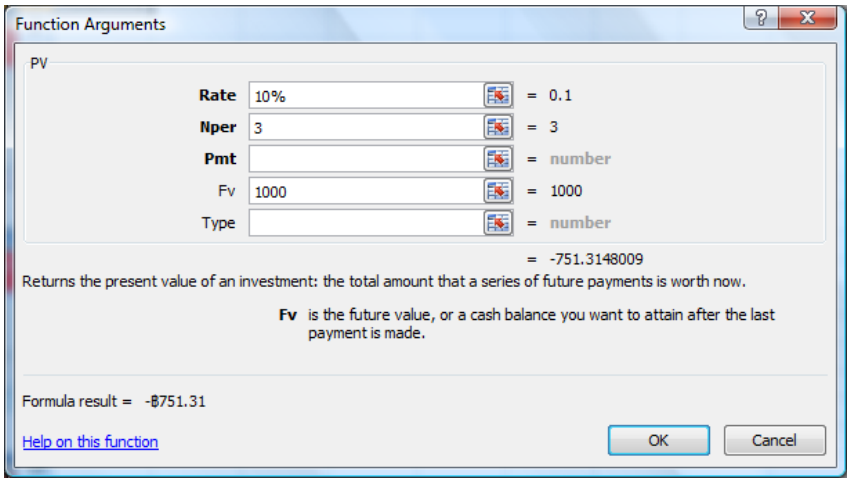
Present Value Calculation with Excel



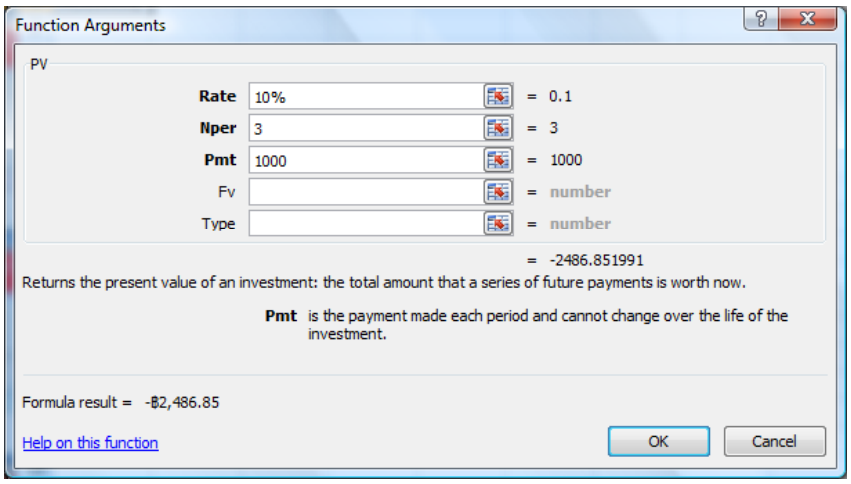
Syntax

PV(rate,nper,pmt,fv,type)

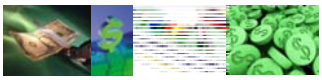
Rate is the interest rate per period.
Nper is the total number of payment periods in an annuity.
Pmt is the payment made each period and cannot change over the life of the annuity. Typically, pmt includes principal and interest but no other fees or taxes. If pmt is omitted, you must include the fv argument.
Fv is the future value, or a cash balance you want to attain after the last payment is made. If fv is omitted, it is assumed to be 0 (the future value of a loan, for example, is 0). You could then make a conservative guess at an interest rate and determine how much you must save each month. If fv is omitted, you must include the pmt argument.
Type is the number 0 or 1 and indicates when payments are due.



Present Value of a Single Sum



Present Value of an Annuity



BA II Plus™ Calculator

BA II PLUS™ Calculator

TVM and Amortization Worksheet Variables

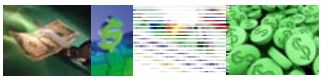
Variable	Key	Display	Type of Variable
Number of periods	[N]	**N**	Enter-or-compute
Interest rate per year	[I/Y]	**I/Y**	Enter-or-compute
Present value	[PV]	**PV**	Enter-or-compute
Payment	[PMT]	**PMT**	Enter-or-compute
Future value	[FV]	**FV**	Enter-or-compute
Number of payments per year	[2nd] [P/Y]	**P/Y**	Enter-only
Number of compounding periods per year	[↓]	**C/Y**	Enter-only
End-of-period payments	[2nd] [BGN]	**END**	Setting
Beginning-of-period payments	[2nd] [SET]	**BGN**	Setting
Starting payment	[2nd] [AMORT]	**P1**	Enter-only
Ending payment	[↓]	**P2**	Enter-only
Balance	[↓]	**BAL**	Auto-compute
Principal paid	[↓]	**PRN**	Auto-compute
Interest paid	[↓]	**INT**	Auto-compute

Resetting the TVM and Amortization Worksheet Variables

- To reset all calculator variables and formats to default values (including TVM and amortization variables), press [2nd] [RESET] [ENTER]:

Variable	Default	Variable	Default
N	0	**END/BGN**	**END**
I/Y	0	**P1**	1
PV	0	**P2**	1
PMT	0	**BAL**	0
FV	0	**PRN**	0
P/Y	1	**INT**	0
C/Y	1		

- To reset only the TVM variables (**N**, **I/Y**, **PV**, **PMT**, **FV**) to default values, press [2nd] [CLR TVM].
- To reset **P/Y** and **C/Y** to default values, press [2nd] [P/Y] [2nd] [CLR WORK].
- To reset the Amortization worksheet variables (**P1**, **P2**, **BAL**, **PRN**, **INT**) to default values, press [2nd] [CLR WORK] while in the Amortization worksheet.
- To reset **END/BGN** to the default value, press [2nd] [BGN] [2nd] [CLR WORK].



BA II Plus™ Calculator (Cont.)

Examples: Computing Value in Savings

These examples show you how to compute the future and present values of a savings account paying 0.5% compounded at the end of each year with a 20-year time frame.

Computing Future Value

Example: If you open the account with $5,000, how much will you have after 20 years?

To	Press	Display	
Set all variables to defaults.	[2nd] [RESET] [ENTER]	**RST**	**0.00**
Enter number of payments.	**20** [N]	**N=**	**20.00**◁
Enter interest rate.	**.5** [I/Y]	**I/Y=**	**0.50**◁
Enter beginning balance.	**5000** [+/−] [PV]	**PV=**	**-5,000.00**◁
Compute future value.	[CPT] [FV]	**FV=**	**5,524.48**∗

Answer: The account will be worth $5,524.48 after 20 years.

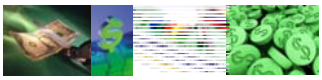
BA II Plus™ Calculator (Cont.)

Computing Present Value

Example: How much money must you deposit to have $10,000 in 20 years?

To	Press		Display
Enter final balance.	**10000** [FV]	**FV=**	**10,000.00**◁
Compute present value.	[CPT] [PV]	**PV=**	**-9,050.63**∗

Answer: You must deposit $9,050.63.

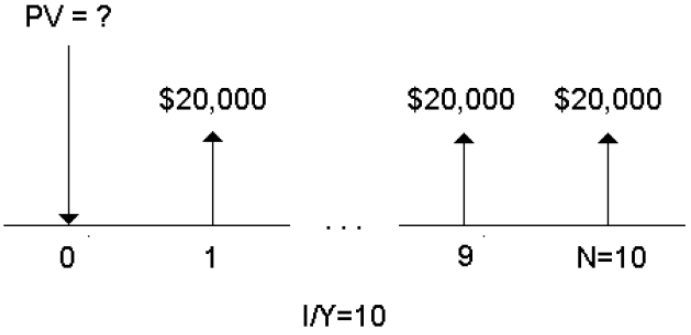


BA II Plus™ Calculator (Cont.)

Example: Computing Present Value in Annuities

The Furros Company purchased equipment providing an annual savings of $20,000 over 10 years. Assuming an annual discount rate of 10%, what is the present value of the savings using an ordinary annuity and an annuity due?

Cost Savings for a Present-Value Ordinary Annuity



BA II Plus™ Calculator (Cont.)

To	Press		Display
Set all variables to defaults.	2nd [RESET] ENTER	RST	0.00
Enter number of payments.	10 N	N=	10.00◁
Enter interest rate per payment period.	10 I/Y	I/Y=	10.00◁
Enter payment.	20000 +/− PMT	PMT=	-20,000.00◁
Compute present value (ordinary annuity).	CPT PV	PV=	122,891.34*