ISE 220
Engineering Economics

University of Economics

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2013, İzmir

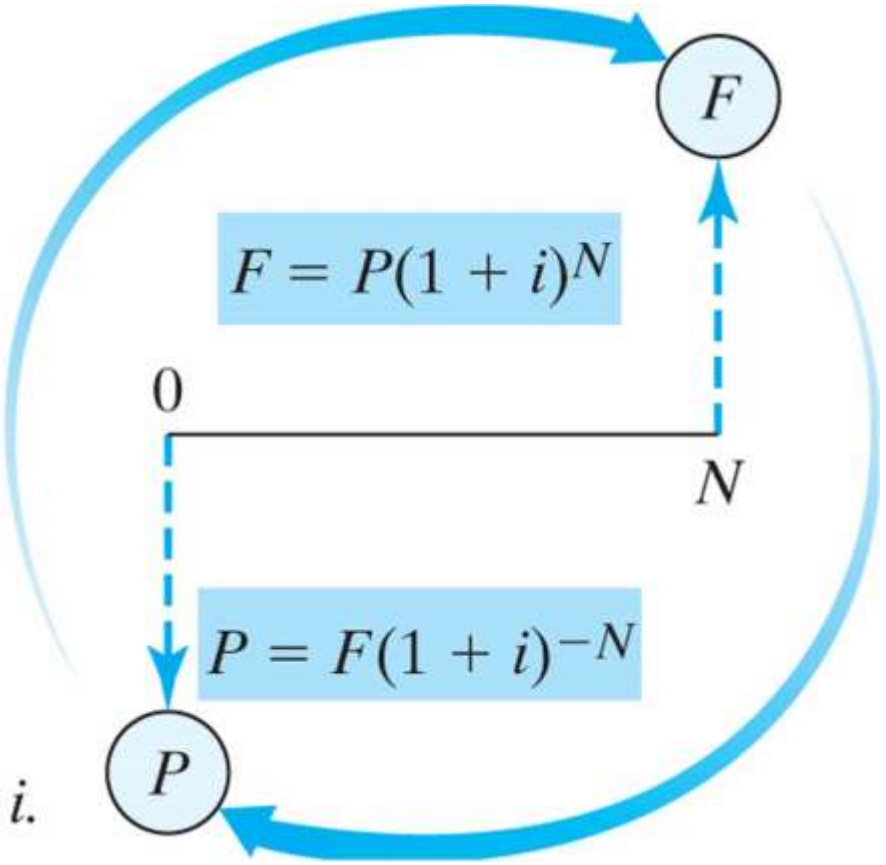
Agenda

- Economic Equivalence
  - Common Time Base
- Single Cash Flow
- Uneven payment series
- Equal Payment Series
- Gradient Series
- Composite Cash Flows

Carrying Values Over Time

By Basic Formula

- If you deposit P dollars today for N periods at i, you will have F dollars at the end of period N.
- F dollars at the end of period N is equal to a single sum of P dollars now if your earning power is measured in terms of the interest rate i.



Economic Equivalence

Carry flow to a common time base

Equalize them at n=0
Write factor notation

- Economic equivalence exists between cash flows that have the *same economic effect* and could therefore be traded for one another.
- Even though the amounts and timing of the cash flows may differ, the appropriate interest rate makes them equal.

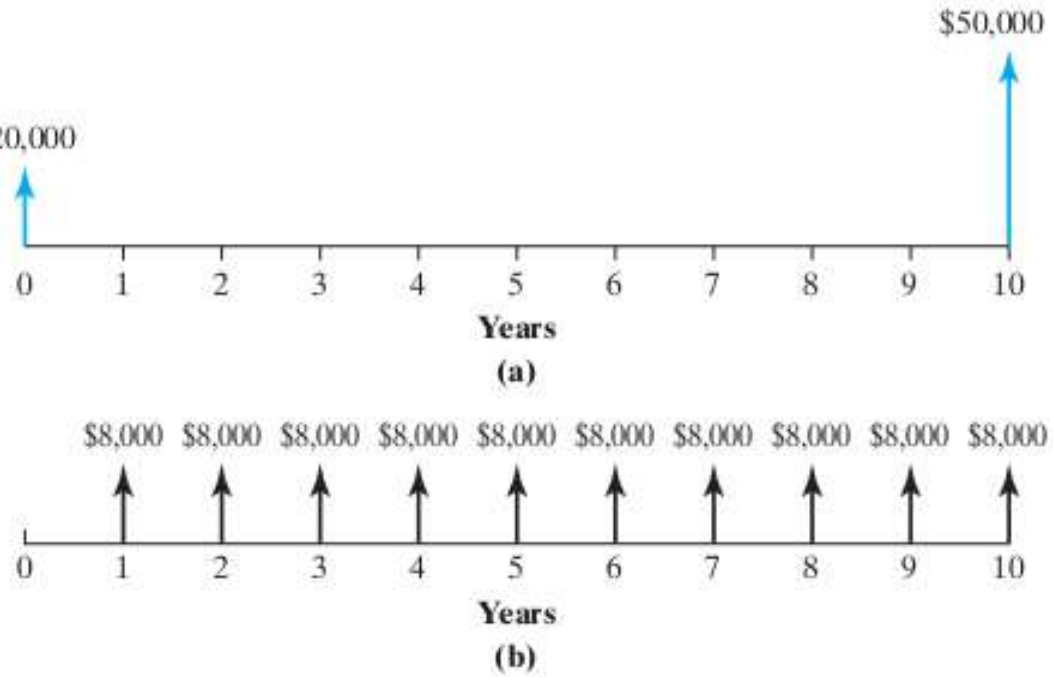
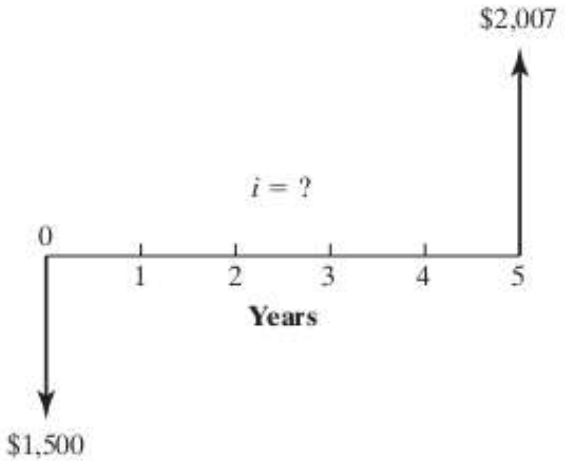


Figure 2.3 Which option would you prefer? (a) Two payments ($20,000 now and $50,000 at the end of 10 years) or (b) 10 equal annual receipts in the amount of $8,000 each

Example 2.2
Equivalence

Suppose you are offered the alternative of receiving either \$2,007 at the end of five years or \$1,500 today. There is no question that the \$2,007 will be paid in full (i.e., there's no risk of nonreceipt). Assuming that the money will not be needed in the next five years, you would deposit the \$1,500 in an account that pays i% interest. What value of i would make you indifferent to your choice between \$1,500 today and the promise of \$2,007 at the end of five years?



$$\$2{,}007 = \$1{,}500(1 + i)^5$$

$$\left(\frac{F}{P}\right)^{1/N} - 1 = \left(\frac{2{,}007}{1{,}500}\right)^{1/5} - 1$$

Equivalence (Example 2.3)
Single time base

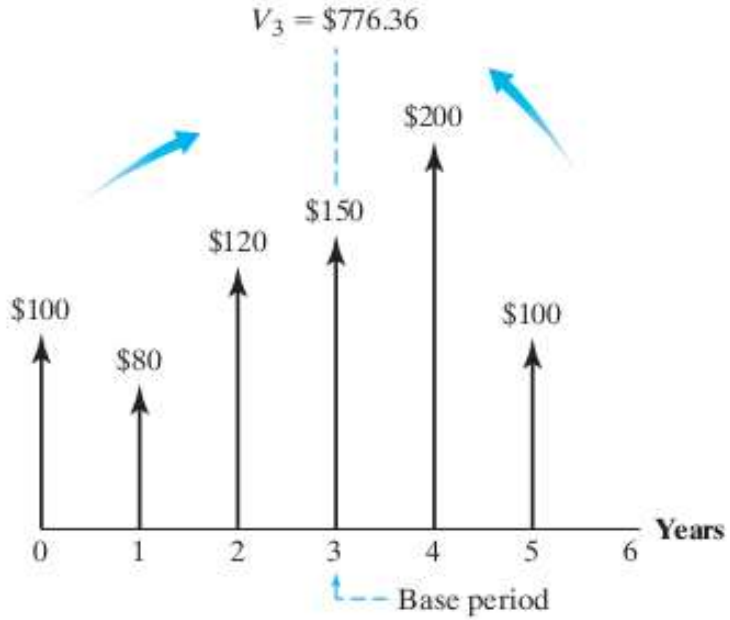


Figure 2.6 Equivalent worth-calculation at $n = 3$

Single Cash Flow
Growth Factor

$$F = P(1 + i)^N = P(F/P,i,N)$$

- *Single-payment compound-amount factor* (growth factor)
- Given:

  $i = 10\%$
  $N = 8$ years
  $P = \$2{,}000$

- Find:

$$F = \$2{,}000(1 + 0.10)^8$$
$$= \$2{,}000(F/P, 10\%, 8)$$
$$= \$4{,}287.18$$

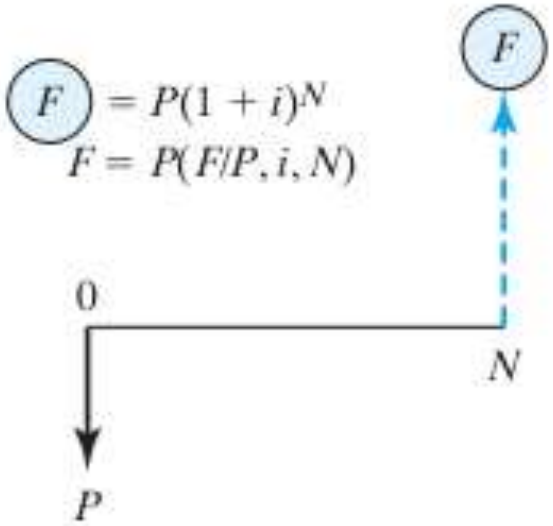


Figure 2.7 Compounding process: Find F, given P, i, and N

Single Cash Flow

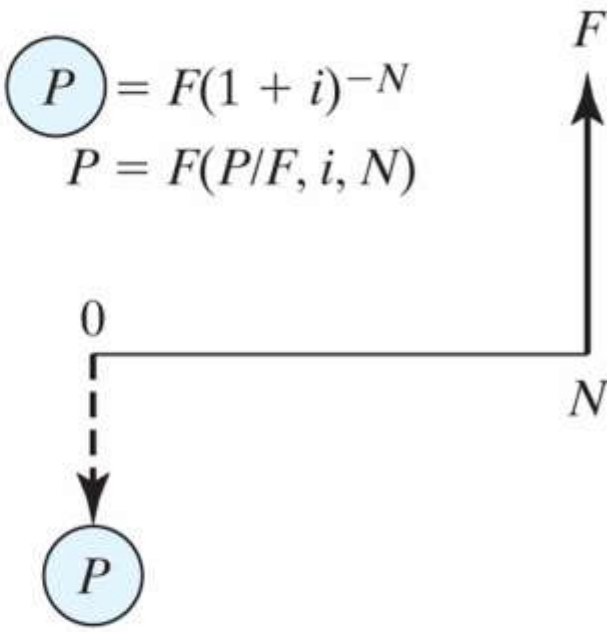
Discount Factor

- *Single-payment present-worth factor (discount factor)*
- Given:

$$i = 12\%$$
$$N = 5 \text{ years}$$
$$F = \$1{,}000$$

- Find:

$$P = \$1{,}000(1 + 0.12)^{-5}$$
$$= \$1{,}000(P/F, 12\%, 5)$$
$$= \$567.40$$



Example

- Suppose that you have a software company developing on-line accounting software. Some other software company wish to buy your company. They offer to pay 10000 today, 5000 next year. The second option is to get half of it (7500) to day and 4000 next year and 5000 at the end of year 2. Which one would you prefer if your expect ROR (or interest rate) is 15% per year.

1. Dissect the problem into notations
2. Draw diagram for both cases
3. Carry both values to year zero to compare. Use factor notations and formulas.

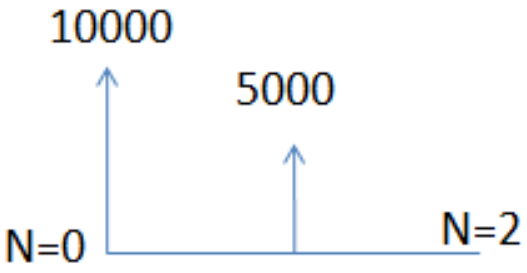
Factor Notations

Case 1

$A_0 = 10000$

$A_1 = 5000$

P= 10000 + 5000(P/F, 15%, 1)



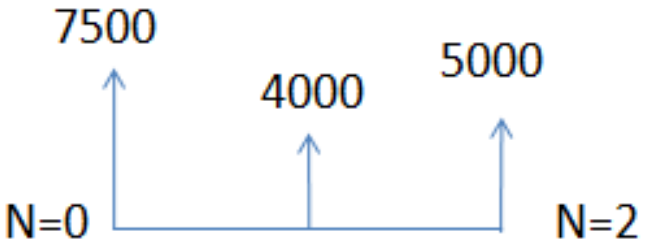
Case 2

$A_0 = 7500$

$A_1 = 4000$

$A_2 = 5000$

P= 7500 + 4000(P/F, 15%, 1) + 5000(P/F, 15%, 2)

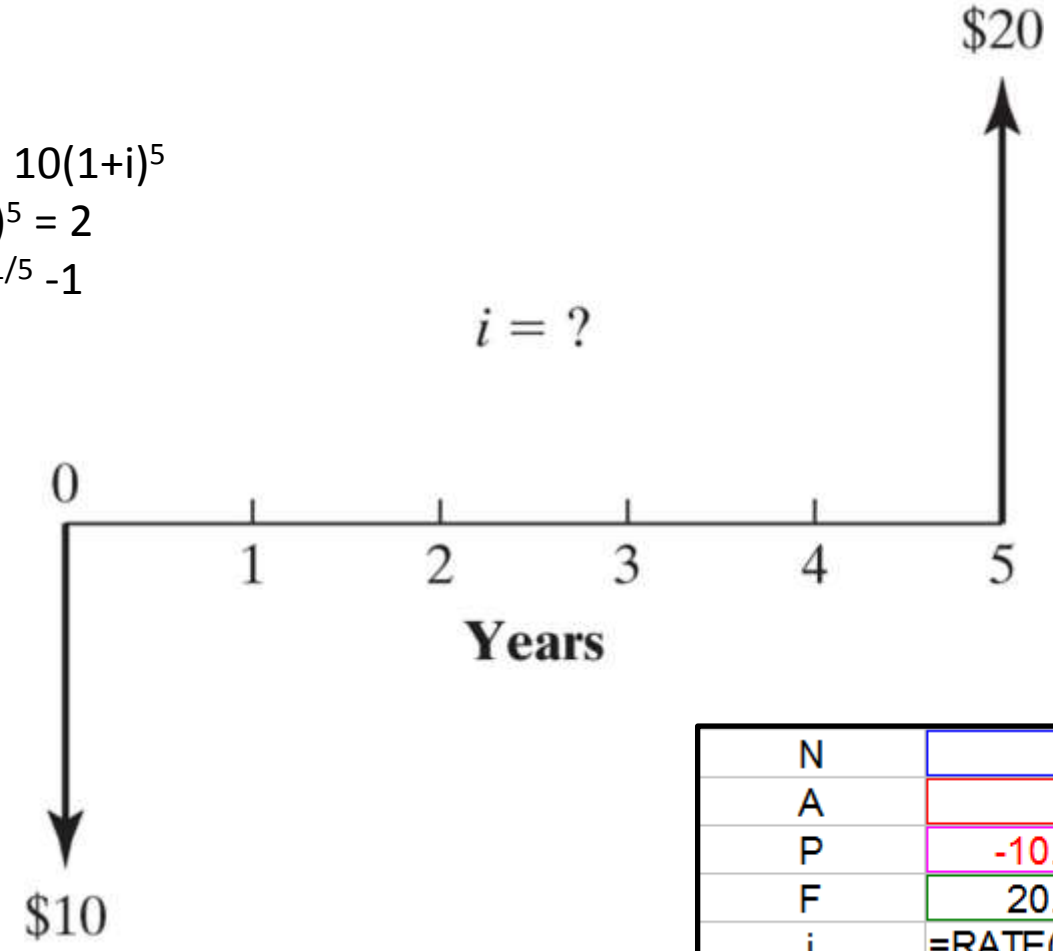


=RATE

$20 = 10(1+i)^5$

$(1+i)^5 = 2$

$i = 2^{1/5} - 1$



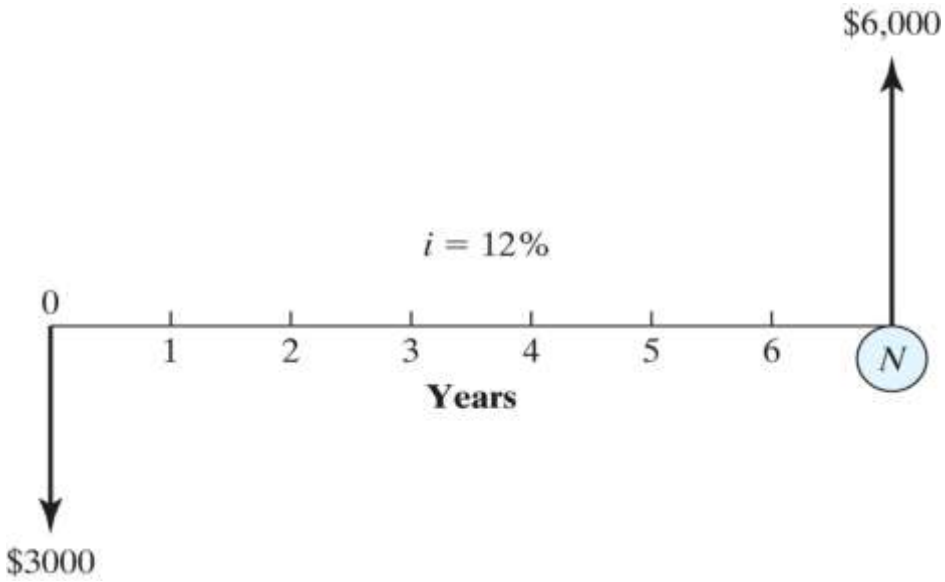
N	5
A	0
P	-10.00TL
F	20.00TL
i	=RATE(B2;B3;B4;B5)

=NPER

$6000 = 3000(1+0.12)^N$

N * Log(1+0.12) = Log2

N = 6.12



i	12.00%	0.12
A	0.00TL	
P	-3,000.00TL	
F	6,000.00TL	
N	=NPER(B2;B3;B4;B5)	

Example

Single Cash Flow

EXAMPLE 2.4 Single Amounts: Find *F*, Given *P*, *i*, and *N*

If you had \$1,000 now and invested it at 7% interest compounded annually, how much would it be worth in eight years (Figure 2.8)?

DISSECTING THE PROBLEM

Given: $P = \$1{,}000, i = 7\%$ per year, and $N = 8$ years.
Find: F.

- Write Factor Notation
- Draw diagram
- Solve
  - ✓ Use Calculator
  - ✓ Use Table values
  - ✓ Use spreadsheet

	A	B	C
1	Single Cash Flow Sample		
2	P=	1000	$
3	*i*=	0.07	7.00%
4	N=	8	Years
5	F=	-$1,718.19	
6			
7	Year (n)	Cash Flow	Cash Balance
8	0	1,000.00TL	1,000.00TL
9	1		1,070.00TL
10	2		1,144.90TL
11	3		1,225.04TL
12	4		1,310.80TL
13	5		1,402.55TL
14	6		1,500.73TL
15	7		1,605.78TL
16	8	-$1,718.19	$0.00

Uneven Payment Series

Example 2.8

The Tuition Prepayment Option (TPO) offered by many colleges provides savings by eliminating future tuition increases. When you enroll in the plan, you prepay all remaining undergraduate tuition and required fees at the rate in effect when you enter the plan. Tuition and fees (not including room and board) for the 2011–2012 academic year are $37,489 at Harvard University. Total undergraduate tuition for an entering freshman at this rate is $149,956. Tuition, fees, room, and board normally increase each year, but it is difficult to predict by how much, since costs depend on future economic trends and institutional priorities. The following chart lists the tuition and required fee rates since 2007:

Academic Year	Tuition and Fees	Required Prepayment
2007–2008	$31,665	$126,660
2008–2009	$32,882	$131,528
2009–2010	$33,983	$135,932
2010–2011	$36,143	$144,572
2011–2012	$37,489	$149,956

Suppose that you enrolled in the TPO for the academic year 2008–2009. In 2012, looking back four years from the time of enrollment, knowing now exactly what the actual tuitions were, do you think your decision was justified in an economic sense to prepay "when money saved or invested was earning" at an interest rate of 6%?

$$P = \$32{,}882 + \$33{,}983(P/F,6\%,1) + \$36{,}143(P/F,6\%,2) + \$37{,}489(P/F,6\%,3)$$
$$= \$128{,}585 < \$131{,}528.$$

Uneven Payment Series

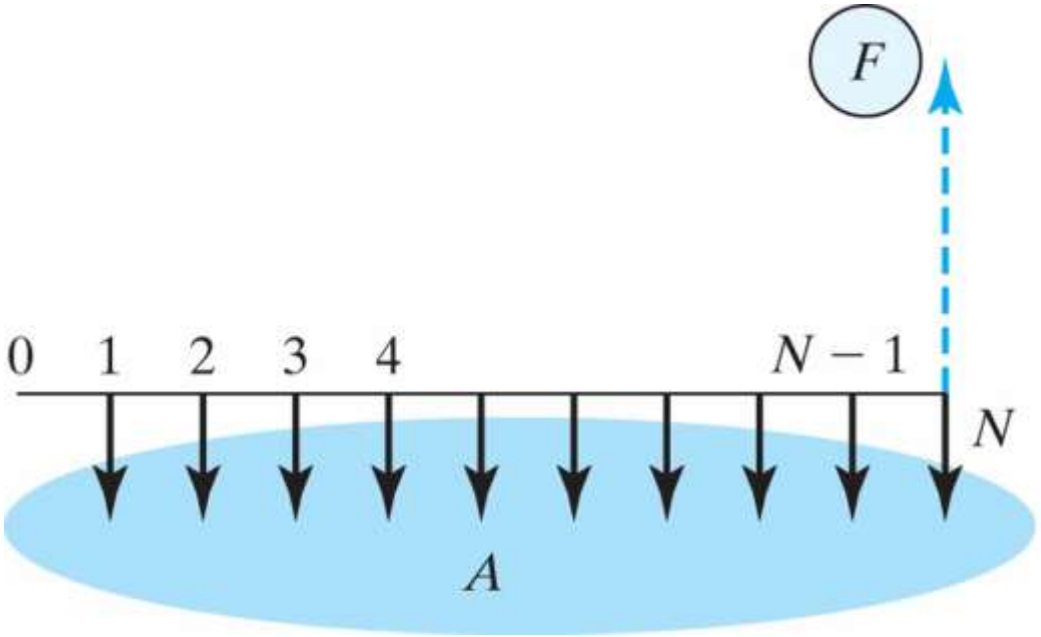
Example 2.8

$$P = \$32{,}882 + \$33{,}983(P/F,6\%,1) + \$36{,}143(P/F,6\%,2) + \$37{,}489(P/F,6\%,3)$$
$$= \$128{,}585 < \$131{,}528.$$

	A	B	C
1	Example 2.8 – Uneven Payment Series		
2	i=	0.06	6.00%
3	P=	=B7+NPV(B2;B8:B10)	
4			
5			
6	Year (n)	Cash Flow	
7	0	$32,882.00	
8	1	$33,983.00	
9	2	$36,143.00	
10	3	$37,489.00	

Equal Payment Series

Next Week



$$F = A\frac{(1+i)^N - 1}{i}$$

$$= A(F/A, i, N)$$

Class work - Homework

Single Payments & Uneven Payment Series

In Class

1. Dissect (P, i, n, F)
2. Draw diagram
3. Write Factor Notations & Calculate

In Class or At Home:

1. Show on spreadsheet & send by e-mail to hposaci@quiztechnology.com

Deadline: Monday 23.59

Class work - Homework

Single Payments & Uneven Payment Series

2.14 State the present worth of the following future payments:

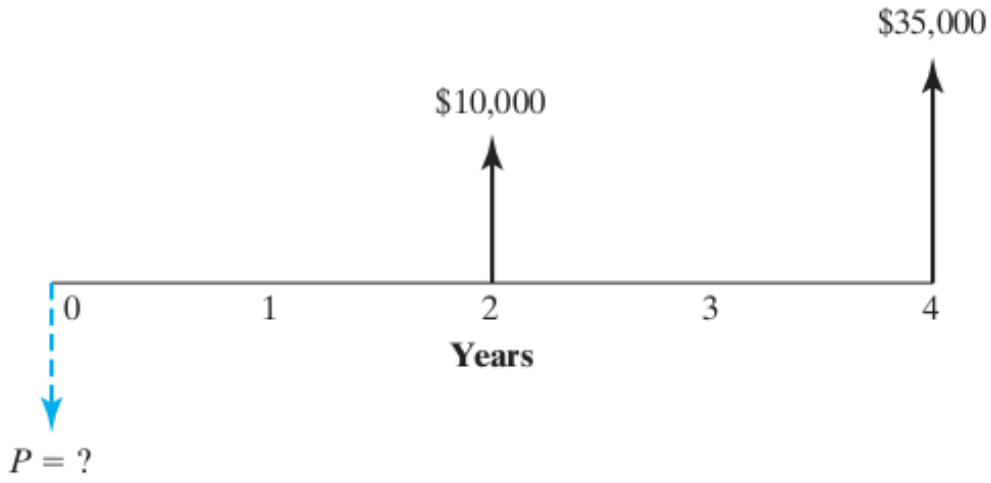
(a) $5,500 six years from now at 10% compounded annually.

(b) $7,000 three years from now at 9% compounded annually.

(c) $22,000 five years from now at 8% compounded annually.

(d) $13,000 eight years from now at 7% compounded annually.

2.20 If you want to withdraw $10,000 at the end of two years and $35,000 at the end of four years, how much should you deposit now into an account that pays 9% interest compounded annually? See the accompanying cash flow diagram.

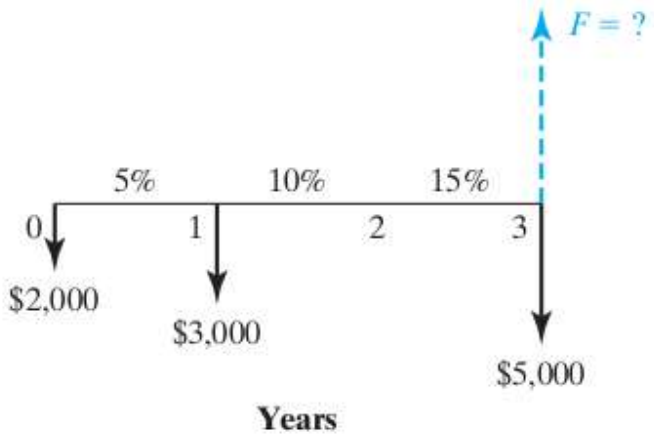


Class work - Homework

Single Payments & Uneven Payment Series

2.18 You bought 100 shares of GE stock at $2,330 on December 31, 2011. Your intention is to keep the stock until it doubles in value. If you expect 8% annual growth for GE stock, how many years do you expect to hold onto the stock? Compare your answer with the solution obtained by the Rule of 72 (discussed in Example 2.7).

2.28 You deposit $2,000 today, $3,000 one year from now, and $5,000 three years from now. How much money will you have at the end of year 3 if there are different annual compound-interest rates per period, according to the accompanying diagram?



Questions

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