

Chapter 4

Time Value of Money

■ Learning Goals

1. Discuss the role of time value in finance, the use of computational aids, and the basic patterns of cash flow.
2. Understand the concept of future value and present value, their calculation for single amounts, and the relationship between them.
3. Find the future value and the present value of both an ordinary annuity and an annuity due, and the present value of a perpetuity.
4. Calculate both the future value and the present value of a mixed stream of cash flows.
5. Understand the effect that compounding interest more frequently than annually has on future value and the effective annual rate of interest.
6. Describe the procedures involved in (1) determining deposits needed to accumulate to a future sum, (2) loan amortization, (3) finding interest or growth rates, and (4) finding an unknown number of periods.

■ True/False Questions

1. Since individuals are always confronted with opportunities to earn positive rates of return on their funds, the timing of cash flows does not have any significant economic consequences.
Answer: FALSE
Level of Difficulty: 1
Learning Goal: 1
Topic: Role of Time Value in Finance
2. Time-value of money is based on the belief that a dollar that will be received at some future date is worth more than a dollar today.
Answer: FALSE
Level of Difficulty: 1
Learning Goal: 1
Topic: Role of Time Value in Finance
3. Future value is the value of a future amount at the present time, found by applying compound interest over a specified period of time.
Answer: FALSE
Level of Difficulty: 1
Learning Goal: 1
Topic: Future Value

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4. Interest earned on a given deposit that has become part of the principal at the end of a specified period is called compound interest.
Answer: TRUE
Level of Difficulty: 1
Learning Goal: 1
Topic: Compound Interest
 5. The future value interest factor is the future value of \$1 per period compounded at i percent for n periods.
Answer: FALSE
Level of Difficulty: 1
Learning Goal: 2
Topic: Future Value
 6. For a given interest rate, the future value of \$100 increases with the passage of time. Thus, the longer the period of time, the greater the future value.
Answer: TRUE
Level of Difficulty: 1
Learning Goal: 2
Topic: Future Value
 7. The greater the potential return on an investment and the longer the period of time, the higher the present value.
Answer: FALSE
Level of Difficulty: 1
Learning Goal: 2
Topic: Present Value
 8. Everything else being equal, the higher the interest rate, the higher the future value.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 2
Topic: Future Value
 9. The future value increases with increases in the interest rate or the period of time funds are left on deposit.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 2
Topic: Future Value
 10. Everything else being equal, the higher the discount rate, the higher the present value.
Answer: FALSE
Level of Difficulty: 2
Learning Goal: 2
Topic: Present Value
 11. Everything else being equal, the longer the period of time, the lower the present value.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 2
Topic: Present Value

12. The present value interest factor for i percent and n periods is the inverse of the future value interest factor for k percent and n periods.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 2
Topic: Present Value
13. Given a discount rate of zero percent and n periods of time, the present-value interest factor and future-value interest factor are equal.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 2
Topic: Present Value
14. Future Value Interest Factor Annuity (FVIFA) is the future value of \$1 ordinary annuity for n period compounded at k percent.
Answer: TRUE
Level of Difficulty: 1
Learning Goal: 3
Topic: Future Value of an Annuity
15. The ordinary annuity is an annuity for which the cash flow occurs at the beginning of each period.
Answer: FALSE
Level of Difficulty: 2
Learning Goal: 3
Topic: Annuities
16. The future value of an annuity due is always greater than the future value of an otherwise identical ordinary annuity.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 3
Topic: Future Value of an Annuity Due
17. The nominal (stated) annual rate is the rate of interest actually paid or earned.
Answer: FALSE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
18. The nominal and effective rates are equivalent for annual compounding.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
19. The effective annual rate increases with increasing compounding frequency.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates

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20. The annual percentage rate (APR) is the nominal rate of interest, found by multiplying the periodic rate by the number of periods in one year.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
21. The annual percentage yield (APY) is the effective rate of interest that must be disclosed to customers by banks on their savings products as a result of “truth in savings laws.”
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
22. The effective rate of interest is the contractual rate of interest charged by a lender or promised by a borrower.
Answer: FALSE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
23. The effective rate of interest differs from the nominal rate of interest in that it reflects the impact of compounding frequency.
Answer: TRUE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
24. For any interest rate and for any period of time, the more frequently interest is compounded, the greater the amount of money that has to be invested today in order to accumulate a given future amount.
Answer: FALSE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
25. The effective rate of interest and compounding frequency are inversely related.
Answer: FALSE
Level of Difficulty: 2
Learning Goal: 5
Topic: Nominal and Effective Interest Rates
26. The loan amortization process involves finding the future payments (over the term of the loan) whose present value at the loan interest rate equals the sum of the amount of initial principal borrowed and the amount of interest on the loan.
Answer: FALSE
Level of Difficulty: 2
Learning Goal: 6
Topic: Loan Amortization

27. In general, with an amortized loan, the payment amount remains constant over the life of the loan, the principal portion of each payment grows over the life of the loan, and the interest portion of each payment declines over the life of the loan.

Answer: TRUE

Level of Difficulty: 2

Learning Goal: 6

Topic: Loan Amortization

28. In general, with an amortized loan, the payment amount remains constant over the life of the loan, the principal portion of each payment grows over the life of the loan, and the interest portion of each payment grows over the life of the loan.

Answer: FALSE

Level of Difficulty: 2

Learning Goal: 6

Topic: Loan Amortization

29. In general, with an amortized loan, the payment amount remains constant over the life of the loan, the principal portion of each payment declines over the life of the loan, and the interest portion declines over the life of the loan.

Answer: FALSE

Level of Difficulty: 2

Learning Goal: 6

Topic: Loan Amortization

30. In general, with an amortized loan, the payment amount grows over the life of the loan, the principal portion of each payment grows over the life of the loan, and the interest portion declines over the life of the loan.

Answer: FALSE

Level of Difficulty: 2

Learning Goal: 6

Topic: Loan Amortization

31. When computing an interest or growth rate, the rate will increase the larger the future value, holding present value and the number of periods constant.

Answer: TRUE

Level of Difficulty: 2

Learning Goal: 6

Topic: Interest or Growth Rates

32. When computing an interest or growth rate, the rate will decrease the larger the future value, holding present value and the number of periods constant.

Answer: FALSE

Level of Difficulty: 2

Learning Goal: 6

Topic: Interest or Growth Rates

33. When computing an interest or growth rate, the rate will increase the smaller the future value, holding present value and the number of periods constant.

Answer: FALSE

Level of Difficulty: 2

Learning Goal: 6

Topic: Interest or Growth Rates

34. When computing the number of deposits needed to accumulate to a future sum, it will take longer the lower the interest rate, holding the future value and deposit size constant.

Answer: TRUE

Level of Difficulty: 2

Learning Goal: 6

Topic: Deposits Needed to Accumulate a Future Sum

35. When computing the number of deposits needed to accumulate to a future sum, it will take longer the higher the interest rate, holding the future value and deposit size constant.

Answer: FALSE

Level of Difficulty: 2

Learning Goal: 6

Topic: Deposits Needed to Accumulate a Future Sum

■ Multiple Choice Questions

1. In future value or present value problems, unless stated otherwise, cash flows are assumed to be
- (a) at the end of a time period.
 - (b) at the beginning of a time period.
 - (c) in the middle of a time period.
 - (d) spread out evenly over a time period.

Answer: A

Level of Difficulty: 1

Learning Goal: 1

Topic: Basic Time Value Concepts

2. When the amount earned on a deposit has become part of the principal at the end of a specified time period the concept is called
- (a) discount interest.
 - (b) compound interest.
 - (c) primary interest.
 - (d) future value.

Answer: B

Level of Difficulty: 1

Learning Goal: 2

Topic: Basic Time Value Concepts

3. The future value interest factor is
- (a) always greater than 1.0.
 - (b) sometimes negative.
 - (c) always less than 0.
 - (d) never greater than 25.

Answer: A

Level of Difficulty: 1

Learning Goal: 2

Topic: Future Value (Equation 4.5)

4. The future value of \$100 received today and deposited at 6 percent for four years is
- (a) \$126.
 - (b) \$ 79.
 - (c) \$124.
 - (d) \$116.

Answer: A

Level of Difficulty: 1

Learning Goal: 2

Topic: Future Value (Equation 4.4, 4.5, 4.6)

5. If the interest rate is zero, the future value interest factor equals_____.
- (a) -1.0
 - (b) 0.0
 - (c) 1.0
 - (d) 2.0

Answer: C

Level of Difficulty: 1

Learning Goal: 2

Topic: Future Value (Equation 4.5)

6. As the interest rate increases for any given period, the future value interest factor will
- (a) decrease.
 - (b) increase.
 - (c) remain unchanged.
 - (d) move toward 1.

Answer: B

Level of Difficulty: 1

Learning Goal: 2

Topic: Future Value (Equation 4.5)

7. The future value of \$200 received today and deposited at 8 percent for three years is
- (a) \$248.
 - (b) \$252.
 - (c) \$158.
 - (d) \$200.

Answer: B

Level of Difficulty: 1

Learning Goal: 2

Topic: Future Value (Equation 4.4, 4.5, 4.6)

8. The present value of \$100 to be received 10 years from today, assuming an opportunity cost of 9 percent, is
- (a) \$236.
 - (b) \$699.
 - (c) \$ 42.
 - (d) \$ 75.

Answer: C

Level of Difficulty: 1

Learning Goal: 2

Topic: Present Value (Equation 4.9, 4.11, 4.12)

9. The amount of money that would have to be invested today at a given interest rate over a specified period in order to equal a future amount is called
- (a) future value.
 - (b) present value.
 - (c) future value interest factor.
 - (d) present value interest factor.

Answer: B

Level of Difficulty: 1

Learning Goal: 2

Topic: Present Value

10. The present value of \$200 to be received 10 years from today, assuming an opportunity cost of 10 percent, is
- (a) \$ 50.
 - (b) \$200.
 - (c) \$518.
 - (d) \$ 77.

Answer: D

Level of Difficulty: 1

Learning Goal: 2

Topic: Present Value (Equation 4.9, 4.11, 4.12)

11. The present value interest factor is
- (a) between 2.0 and 0.0.
 - (b) always negative.
 - (c) always less than 1.0.
 - (d) a discount rate.

Answer: C

Level of Difficulty: 1

Learning Goal: 2

Topic: Present Value (Equation 4.11)

12. The future value of a dollar _____ as the interest rate increases and _____ the farther in the future an initial deposit is to be received.
- (a) decreases; decreases
 - (b) decreases; increases
 - (c) increases; increases
 - (d) increases; decreases

Answer: C

Level of Difficulty: 2

Learning Goal: 2

Topic: Future Value

13. The annual rate of return is variously referred to as the
- (a) discount rate.
 - (b) opportunity cost.
 - (c) cost of capital.
 - (d) all of the above.

Answer: D

Level of Difficulty: 2

Learning Goal: 2

Topic: Basic Time Value Concepts

14. If the present-value interest factor for i percent and n periods is 0.270, the future-value interest factor for the same i and n is
- (a) 0.730.
 - (b) 3.797.
 - (c) 3.704.
 - (d) cannot be determined.

Answer: C

Level of Difficulty: 2

Learning Goal: 2

Topic: Basic Time Value Concepts (Equation 4.5)

15. For a given interest rate, as the length of time until receipt of the funds increases, the present value interest factor
- (a) changes proportionally.
 - (b) increases.
 - (c) decreases.
 - (d) remains unchanged.

Answer: C

Level of Difficulty: 2

Learning Goal: 2

Topic: Present Value (Equation 4.11)

16. Indicate which formula is correct to determine the future value of an annuity due.
- (a) $FVAs = PMT \times FVIFA_{i,n}$
 - (b) $FVAs = PMT \times [FVIFA_{i,n} \times (1 + i)]$
 - (c) $FVAs = PMT \times [FVIFA_{i,n}/(1 + i)]$
 - (d) $FVAs = PMT \times FVIFA_{i,n} + 1$

Answer: B

Level of Difficulty: 1

Learning Goal: 3

Topic: Future Value of an Annuity (Equation 4.17)

17. The present value of a \$25,000 perpetuity at a 14 percent discount rate is
- (a) \$178,571.
 - (b) \$285,000.
 - (c) \$350,000.
 - (d) \$219,298.

Answer: A

Level of Difficulty: 1

Learning Goal: 3

Topic: Perpetuities (Equation 4.19)

18. An annuity with an infinite life is called a(n)
- (a) perpetuity.
 - (b) primia.
 - (c) indefinite.
 - (d) deep discount.

Answer: A

Level of Difficulty: 1

Learning Goal: 3

Topic: Perpetuities

19. The present value of a \$20,000 perpetuity at a 7 percent discount rate is
- (a) \$186,915.
 - (b) \$285,714.
 - (c) \$140,000.
 - (d) \$325,000.

Answer: B

Level of Difficulty: 1

Learning Goal: 3

Topic: Perpetuities (Equation 4.19)

20. _____ is an annuity with an infinite life making continual annual payments.
- (a) An amortized loan
 - (b) A principal
 - (c) A perpetuity
 - (d) An APR

Answer: C

Level of Difficulty: 1

Learning Goal: 3

Topic: Perpetuities

21. Bill plans to fund his individual retirement account (IRA) with the maximum contribution of \$2,000 at the end of each year for the next 20 years. If Bill can earn 12 percent on his contributions, how much will he have at the end of the twentieth year?
- (a) \$19,292
 - (b) \$14,938
 - (c) \$40,000
 - (d) \$144,104

Answer: D

Level of Difficulty: 2

Learning Goal: 3

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

22. Dan plans to fund his individual retirement account (IRA) with the maximum contribution of \$2,000 at the end of each year for the next 10 years. If Dan can earn 10 percent on his contributions, how much will he have at the end of the tenth year?
- (a) \$12,290
 - (b) \$20,000
 - (c) \$31,874
 - (d) \$51,880

Answer: C

Level of Difficulty: 2

Learning Goal: 3

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

23. The future value of an ordinary annuity of \$1,000 each year for 10 years, deposited at 3 percent, is
- (a) \$11,808.
 - (b) \$11,464.
 - (c) \$ 8,530.
 - (d) \$10,000.

Answer: B

Level of Difficulty: 2

Learning Goal: 3

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

24. The future value of an ordinary annuity of \$2,000 each year for 10 years, deposited at 12 percent, is
- (a) \$35,098.
 - (b) \$20,000.
 - (c) \$39,310.
 - (d) \$11,300.

Answer: A

Level of Difficulty: 2

Learning Goal: 3

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

25. A college received a contribution to its endowment fund of \$2 million. They can never touch the principal, but they can use the earnings. At an assumed interest rate of 9.5 percent, how much can the college earn to help its operations each year?
- (a) \$95,000
 - (b) \$19,000
 - (c) \$190,000
 - (d) \$18,000
- Answer: C
Level of Difficulty: 2
Learning Goal: 3
Topic: Perpetuities (Equation 4.19)
26. If the present value of a perpetual income stream is increasing, the discount rate must be
- (a) increasing.
 - (b) decreasing.
 - (c) changing unpredictably.
 - (d) increasing proportionally.
- Answer: B
Level of Difficulty: 2
Learning Goal: 3
Topic: Perpetuities
27. The present value of an ordinary annuity of \$350 each year for five years, assuming an opportunity cost of 4 percent, is
- (a) \$288.
 - (b) \$1,896.
 - (c) \$1,750.
 - (d) \$1,558.
- Answer: D
Level of Difficulty: 2
Learning Goal: 3
Topic: Present Value of an Annuity (Equation 4.15, 4.16)
28. The present value of an ordinary annuity of \$2,350 each year for eight years, assuming an opportunity cost of 11 percent, is
- (a) \$ 1,020.
 - (b) \$27,869.
 - (c) \$18,800.
 - (d) \$12,093.
- Answer: D
Level of Difficulty: 2
Learning Goal: 3
Topic: Present Value of an Annuity (Equation 4.15, 4.16)

29. A generous benefactor to the local ballet plans to make a one-time endowment which would provide the ballet with \$150,000 per year into perpetuity. The rate of interest is expected to be 5 percent for all future time periods. How large must the endowment be?
- (a) \$ 300,000
 - (b) \$3,000,000
 - (c) \$ 750,000
 - (d) \$1,428,571

Answer: B

Level of Difficulty: 2

Learning Goal: 3

Topic: Perpetuities (Equation 4.19)

30. A generous philanthropist plans to make a one-time endowment to a renowned heart research center which would provide the facility with \$250,000 per year into perpetuity. The rate of interest is expected to be 8 percent for all future time periods. How large must the endowment be?
- (a) \$2,314,814
 - (b) \$2,000,000
 - (c) \$3,125,000
 - (d) \$3,000,000

Answer: C

Level of Difficulty: 2

Learning Goal: 3

Topic: Perpetuities (Equation 4.19)

31. Mary will receive \$12,000 per year for the next 10 years as royalty for her work on a finance book. What is the present value of her royalty income if the opportunity cost is 12 percent?
- (a) \$120,000
 - (b) \$ 67,800
 - (c) \$ 38,640
 - (d) None of the above.

Answer: B

Level of Difficulty: 2

Learning Goal: 3

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

32. \$100 is received at the beginning of year 1, \$200 is received at the beginning of year 2, and \$300 is received at the beginning of year 3. If these cash flows are deposited at 12 percent, their combined future value at the end of year 3 is _____.
- (a) \$1,536
 - (b) \$ 672
 - (c) \$ 727
 - (d) \$1,245

Answer: C

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.4, 4.5, 4.6)

33. \$1,200 is received at the beginning of year 1, \$2,200 is received at the beginning of year 2, and \$3,300 is received at the beginning of year 3. If these cash flows are deposited at 12 percent, their combined future value at the end of year 3 is _____.
- (a) \$ 6,700
 (b) \$17,000
 (c) \$12,510
 (d) \$ 8,141

Answer: D

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.4, 4.5, 4.6)

34. Find the future value at the end of year 3 of the following stream of cash flows received at the end of each year, assuming the firm can earn 17 percent on its investments.

Year	Amount
1	\$3,000
2	6,000
3	9,000

- (a) \$20,724
 (b) \$20,127
 (c) \$23,550
 (d) \$23,350

Answer: B

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.4, 4.5, 4.6)

35. Find the future value at the end of year 3 of the following stream of cash flows received at the end of each year, assuming the firm can earn 8 percent on its investments.

Year	Amount
1	\$10,000
2	16,000
3	19,000

- (a) \$45,000
 (b) \$53,396
 (c) \$47,940
 (d) \$56,690

Answer: C

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.4, 4.5, 4.6)

36. The present value of \$1,000 received at the end of year 1, \$1,200 received at the end of year 2, and \$1,300 received at the end of year 3, assuming an opportunity cost of 7 percent, is
- (a) \$2,500.
 - (b) \$3,043.
 - (c) \$6,516.
 - (d) \$2,856.

Answer: B

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12)

37. The present value of \$100 received at the end of year 1, \$200 received at the end of year 2, and \$300 received at the end of year 3, assuming an opportunity cost of 13 percent, is
- (a) \$ 453.
 - (b) \$ 416.
 - (c) \$1,181.
 - (d) \$ 500.

Answer: A

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12)

38. Find the present value of the following stream of cash flows, assuming that the firm's opportunity cost is 14 percent.

Year	Amount
1	\$10,000
2	35,000
3	24,000

- (a) \$121,256
- (b) \$ 69,000
- (c) \$ 60,513
- (d) \$ 51,885

Answer: D

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12)

39. Find the present value of the following stream of cash flows, assuming that the firm's opportunity cost is 25 percent.

Year	Amount
1	\$ 5,000
2	25,000
3	14,000

- (a) \$27,168
 (b) \$35,200
 (c) \$34,000
 (d) \$32,500

Answer: A

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12)

40. Find the present value of the following stream of cash flows, assuming that the firm's opportunity cost is 9 percent.

Year	Amount
1–5	\$10,000/yr.
6–10	16,000/yr.

- (a) \$ 13,252
 (b) \$141,588
 (c) \$ 10,972
 (d) \$ 79,348

Answer: D

Level of Difficulty: 4

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12, 4.15, 4.16)

41. Find the present value of the following stream of cash flows, assuming that the firm's opportunity cost is 14 percent.

Year	Amount
1–5	\$20,000/yr.
6–10	35,000/yr.

- (a) \$131,065
 (b) \$ 19,830
 (c) \$ 14,850
 (d) \$120,820

Answer: A

Level of Difficulty: 4

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12, 4.15, 4.16)

42. The rate of interest agreed upon contractually charged by a lender or promised by a borrower is the _____ interest rate.

- (a) effective
- (b) nominal
- (c) discounted
- (d) continuous

Answer: B

Level of Difficulty: 1

Learning Goal: 5

Topic: Nominal and Effective Interest Rates

43. The rate of interest actually paid or earned, also called the annual percentage rate (APR), is the _____ interest rate.

- (a) effective
- (b) nominal
- (c) discounted
- (d) continuous

Answer: A

Level of Difficulty: 1

Learning Goal: 5

Topic: Nominal and Effective Interest Rates

44. The future value of \$200 received today and deposited at 8 percent compounded semi-annually for three years is

- (a) \$380.
- (b) \$158.
- (c) \$253.
- (d) \$252.

Answer: C

Level of Difficulty: 2

Learning Goal: 5

Topic: Future Value (Equation 4.4, 4.5, 4.6)

45. The future value of \$100 received today and deposited in an account for four years paying semiannual interest of 6 percent is

- (a) \$450.
- (b) \$126.
- (c) \$889.
- (d) \$134.

Answer: B

Level of Difficulty: 2

Learning Goal: 5

Topic: Future Value (Equation 4.4, 4.5, 4.6)

46. The future value of \$200 received today and deposited for three years in an account which pays semiannual interest of 8 percent is _____.

- (a) \$253.00
- (b) \$252.00
- (c) \$158.00
- (d) \$134.66

Answer: A

Level of Difficulty: 2

Learning Goal: 5

Topic: Future Value (Equation 4.4, 4.5, 4.6)

47. The future value of an annuity of \$1,000 each year for 10 years, deposited at 12 percent compounded quarterly is

- (a) \$17,549.
- (b) \$75,400.
- (c) \$93,049.
- (d) \$11,200.

Answer: B

Level of Difficulty: 2

Learning Goal: 5

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

48. What is the highest effective rate attainable with a 12 percent nominal rate?

- (a) 12.00%
- (b) 12.55%
- (c) 12.75%
- (d) 12.95%

Answer: C

Level of Difficulty: 3

Learning Goal: 5

Topic: Nominal and Effective Interest Rates (Equation 4.23)

49. Gina has planned to start her college education four years from now. To pay for her college education, she has decided to save \$1,000 a quarter for the next four years in a bank account paying 12 percent interest. How much will she have at the end of the fourth year?

- (a) \$ 1,574
- (b) \$19,116
- (c) \$20,157
- (d) \$16,000

Answer: C

Level of Difficulty: 3

Learning Goal: 5

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

50. The time value concept/calculation used in amortizing a loan is
- (a) future value of a dollar.
 - (b) future value of an annuity.
 - (c) present value of a dollar.
 - (d) present value of an annuity.

Answer: D

Level of Difficulty: 1

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

51. If a United States Savings bond can be purchased for \$29.50 and has a maturity value at the end of 25 years of \$100, what is the annual rate of return on the bond?
- (a) 5 percent
 - (b) 6 percent
 - (c) 7 percent
 - (d) 8 percent

Answer: A

Level of Difficulty: 2

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6, or 4.9, 4.11, 4.12)

52. If a United States Savings bond can be purchased for \$14.60 and has a maturity value at the end of 25 years of \$100, what is the annual rate of return on the bond?
- (a) 6 percent
 - (b) 7 percent
 - (c) 8 percent
 - (d) 9 percent

Answer: C

Level of Difficulty: 2

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6, 4.9, 4.11, 4.12)

53. Janice would like to send her parents on a cruise for their 25th wedding anniversary. She has priced the cruise at \$15,000 and she has 5 years to accumulate this money. How much must Janice deposit annually in an account paying 10 percent interest in order to have enough money to send her parents on the cruise?
- (a) \$1,862
 - (b) \$2,457
 - (c) \$3,000
 - (d) \$2,234

Answer: B

Level of Difficulty: 2

Learning Goal: 6

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

54. Marla borrows \$4,500 at 12 percent annually compounded interest to be repaid in four equal annual installments. The actual end-of-year payment is
- (a) \$ 942.
 - (b) \$1,125.
 - (c) \$1,482.
 - (d) \$2,641.

Answer: C

Level of Difficulty: 2

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

55. Betty borrows \$50,000 at 10 percent annually compounded interest to be repaid in four equal annual installments. The actual end-of-year loan payment is
- (a) \$10,774.
 - (b) \$12,500.
 - (c) \$14,340.
 - (d) \$15,773.

Answer: D

Level of Difficulty: 2

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

56. Donna makes annual end-of-year payments of \$5,043.71 on a four-year loan with an interest rate of 13 percent. The original principal amount was
- (a) \$24,462.
 - (b) \$15,000.
 - (c) \$ 3,092.
 - (d) \$20,175.

Answer: B

Level of Difficulty: 2

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

57. Marion makes annual end-of-year payments of \$6,260.96 on a five-year loan with an 8 percent interest rate. The original principal amount was
- (a) \$31,000.
 - (b) \$30,000.
 - (c) \$25,000.
 - (d) \$20,000.

Answer: C

Level of Difficulty: 2

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

58. Charlene owns stock in a company which has consistently paid a growing dividend over the last five years. The first year Charlene owned the stock, she received \$1.71 per share and in the fifth year, she received \$2.89 per share. What is the growth rate of the dividends over the last five years?
- (a) 7 percent
 - (b) 14 percent
 - (c) 12 percent
 - (d) 5 percent

Answer: B

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6, or 4.9, 4.11, 4.12)

59. Julian was given a gold coin originally purchased for \$1 by his great-grandfather 50 years ago. Today the coin is worth \$450. The rate of return realized on the sale of this coin is approximately equal to
- (a) 7.5%.
 - (b) 13%.
 - (c) 50%.
 - (d) can not be determined with given information.

Answer: B

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6, or 4.9, 4.11, 4.12)

60. Young Sook owns stock in a company which has consistently paid a growing dividend over the last 10 years. The first year Young Sook owned the stock, she received \$4.50 per share and in the 10th year, she received \$4.92 per share. What is the growth rate of the dividends over the last 10 years?
- (a) 5 percent
 - (b) 4 percent
 - (c) 2 percent
 - (d) 1 percent

Answer: D

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6, or 4.9, 4.11, 4.12)

61. The rate of return earned on an investment of \$50,000 today that guarantees an annuity of \$10,489 for six years is approximately
- (a) 5%.
 - (b) 7%.
 - (c) 30%.
 - (d) none of the above.

Answer: B

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

62. What is the rate of return on an investment of \$16,278 if the company expects to receive \$3,000 per year for the next 10 years?
- (a) 18 percent
 - (b) 13 percent
 - (c) 8 percent
 - (d) 3 percent

Answer: B

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

63. What is the rate of return on an investment of \$124,090 if the company expects to receive \$10,000 per year for the next 30 years?
- (a) 7 percent
 - (b) 4 percent
 - (c) 1 percent
 - (d) 0 percent

Answer: A

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

64. A local brokerage firm is offering a zero coupon certificate of deposit for \$10,000. At maturity, three years from now, the investor will receive \$14,000. What is the rate of return on this investment?
- (a) 14 percent
 - (b) 13 percent
 - (c) 12 percent
 - (d) 11 percent

Answer: C

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6, or 4.9, 4.11, 4.12)

65. A local bank is offering a zero coupon certificate of deposit for \$25,000. At maturity, three years from now, the investor will receive \$32,000. What is the rate of return on this investment?
- (a) 3 percent
 - (b) 6 percent
 - (c) 9 percent
 - (d) 12 percent

Answer: C

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6, or 4.9, 4.11, 4.12)

66. A ski chalet in Aspen now costs \$250,000. Inflation is expected to cause this price to increase at 5 percent per year over the next 10 years before Barbara and Phil retire from successful investment banking careers. How large an equal annual end-of-year deposit must be made into an account paying an annual rate of interest of 13 percent in order to buy the ski chalet upon retirement?
- (a) \$ 8,333
 - (b) \$13,572
 - (c) \$25,005
 - (d) \$22,109
- Answer: D
Level of Difficulty: 3
Learning Goal: 6
Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6, and 4.13, 4.14)
67. A beach house in southern California now costs \$350,000. Inflation is expected to cause this price to increase at 5 percent per year over the next 20 years before Louis and Kate retire from successful careers in commercial art. How large an equal annual end-of-year deposit must be made into an account paying an annual rate of interest of 13 percent in order to buy the beach house upon retirement?
- (a) \$11,471
 - (b) \$ 4,323
 - (c) \$79,977
 - (d) \$17,350
- Answer: A
Level of Difficulty: 3
Learning Goal: 6
Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6, and 4.13, 4.14)
68. David wishes to accumulate \$1 million by the end of 20 years by making equal annual end-of-year deposits over the next 20 years. If David can earn 10 percent on his investments, how much must he deposit at the end of each year?
- (a) \$ 14,900
 - (b) \$ 50,000
 - (c) \$117,453
 - (d) \$ 17,460
- Answer: D
Level of Difficulty: 3
Learning Goal: 6
Topic: Future Value of an Annuity (Equation 4.13, 4.14)
69. Darlene wishes to accumulate \$50,000 by the end of 10 years by making equal annual end-of-year deposits over the next 10 years. If Darlene can earn 5 percent on her investments, how much must she deposit at the end of each year?
- (a) \$3,975
 - (b) \$6,475
 - (c) \$5,000
 - (d) \$4,513
- Answer: A
Level of Difficulty: 3
Learning Goal: 6
Topic: Future Value of an Annuity (Equation 4.13, 4.14)

70. Kathy borrows \$10,000 from the bank. For a four-year loan, the bank requires annual end-of-year payments of \$3,223.73. The annual interest rate on the loan is
- (a) 9 percent.
 - (b) 10 percent.
 - (c) 11 percent.
 - (d) 12 percent.

Answer: C

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

71. Carol borrows \$20,000 from the bank. For a five-year loan, the bank requires annual end-of-year payments of \$4,878.05. The annual interest rate on the loan is
- (a) 6 percent.
 - (b) 7 percent.
 - (c) 8 percent.
 - (d) 9 percent.

Answer: B

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

72. Chris is planning for her son's college education to begin five years from today. She estimates the yearly tuition, books, and living expenses to be \$5,000 per year for a four-year degree. How much must Chris deposit today, at an interest rate of 8 percent, for her son to be able to withdraw \$5,000 per year for four years of college?
- (a) \$20,000
 - (b) \$13,620
 - (c) \$39,520
 - (d) \$11,277

Answer: D

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6, and 4.15, 4.16)

73. Michael is planning for his son's college education to begin ten years from today. He estimates the yearly tuition, books, and living expenses to be \$10,000 per year for a four-year degree. How much must Michael deposit today, at an interest rate of 12 percent, for his son to be able to withdraw \$10,000 per year for four years of college?
- (a) \$12,880
 - (b) \$ 9,780
 - (c) \$40,000
 - (d) \$18,950

Answer: B

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6, and 4.15, 4.16)

74. Debbie borrows \$3,500 from the bank at 12 percent annually compounded interest to be repaid in four equal annual installments. The interest paid in the first year is
- (a) \$ 152.
 - (b) \$ 277.
 - (c) \$ 420.
 - (d) \$1,152.

Answer: C

Level of Difficulty: 4

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

75. Robert borrows \$10,500 from the bank at 11 percent annually compounded interest to be repaid in six equal annual installments. The interest paid in the first year is
- (a) \$1,155.
 - (b) \$2,481.
 - (c) \$ 144.
 - (d) \$1,327.

Answer: A

Level of Difficulty: 4

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

76. Teffan borrows \$4,500 from the bank at 9 percent annually compounded interest to be repaid in three equal annual installments. The interest paid in the third year is _____.
- (a) \$277.95
 - (b) \$405.00
 - (c) \$352.00
 - (d) \$147.00

Answer: D

Level of Difficulty: 4

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

77. Pam borrows \$19,500 from the bank at 8 percent annually compounded interest to be repaid in 10 equal annual installments. The interest paid in the third year is _____.
- (a) \$1,336.00
 - (b) \$1,560.14
 - (c) \$2,906.11
 - (d) \$1,947.10

Answer: A

Level of Difficulty: 4

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

78. Entertainer's Aid plans five annual colossal concerts, each in a different nation's capital. The concerts will raise funds for an endowment which would provide the World Wide Hunger Fund with \$3,000,000 per year into perpetuity. The endowment will be given at the end of the fifth year. The rate of interest is expected to be 9 percent in all future periods. How much must Entertainer's Aid deposit each year to accumulate to the required amount?
- (a) \$5,569,479
 - (b) \$3,333,333
 - (c) \$1,830,275
 - (d) \$8,568,980

Answer: A

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.13, 4.14 and 4.19)

79. A wealthy art collector has decided to endow her favorite art museum by establishing funds for an endowment which would provide the museum with \$1,000,000 per year for acquisitions into perpetuity. The art collector will give the endowment upon her fiftieth birthday 10 years from today. She plans to accumulate the endowment by making annual end-of-year deposits into an account. The rate of interest is expected to be 6 percent in all future periods. How much must the art collector deposit each year to accumulate to the required amount?
- (a) \$1,575,333
 - (b) \$ 736,000
 - (c) \$1,264,446
 - (d) \$ 943,396

Answer: C

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.13, 4.14 and 4.19)

80. How long would it take for you to save an adequate amount for retirement if you deposit \$40,000 per year into an account beginning one year from today that pays 12 percent per year if you wish to have a total of \$1,000,000 at retirement?
- (a) 15.0 years
 - (b) 15.5 years
 - (c) 14.5 years
 - (d) 16.5 years

Answer: A

Level of Difficulty: 2

Learning Goal: 6

Topic: Finding an Unknown Number of Periods (Equation 4.13, 4.14)

81. What annual rate of return would you need to earn if you deposit \$20,000 per year into an account beginning one year from today in order to have a total of \$1,000,000 in 30 years?

- (a) 2.3%
- (b) 3.3%
- (c) 1.3%
- (d) 4.3%

Answer: B

Level of Difficulty: 2

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.13, 4.14)

82. What annual rate of return would you need to earn if you deposit \$1,000 per month into an account beginning one month from today in order to have a total of \$1,000,000 in 30 years?

- (a) 4.55%
- (b) 5.28%
- (c) 5.98%
- (d) 6.23%

Answer: C

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.13, 4.14)

83. What effective annual rate of return (EAR) would you need to earn if you deposit \$1,000 per month into an account beginning one month from today in order to have a total of \$1,000,000 in 30 years?

- (a) 5.98%
- (b) 6.55%
- (c) 4.87%
- (d) 6.14%

Answer: A

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.13, 4.14)

84. How much would you have in your account at the end of 10 years if you deposit \$2,000 into the account today if you earn 8 percent interest and interest is compounded continuously?

- (a) \$4,317
- (b) \$4,444
- (c) \$4,451
- (d) \$4,521

Answer: C

Level of Difficulty: 3

Learning Goal: 5

Topic: Continuous Compounding (Equation 4.21, 4.22)

85. Assume you have a choice between two deposit accounts. Account A has an annual percentage rate of 7.55 percent but with interest compounded monthly. Account B has an annual percentage rate of 7.45 percent with interest compounded continuously. Which account provides the highest effective annual return?
- Account A.
 - Account B.
 - Both provide the same effective annual return.
 - We don't have sufficient information to make a choice.

Answer: A

Level of Difficulty: 4

Learning Goal: 5

Topic: Continuous Compounding and Effective Annual Rate (Equation 4.21, 4.22, 4.23)

■ Essay Questions

- Calculate the future value of \$4,600 received today if it is deposited at 9 percent for three years.
Answer: $FV = \$4,600(1.295) = \$5,957$
 Level of Difficulty: 1
 Learning Goal: 2
 Topic: Future Value (Equation 4.4, 4.5, and 4.6)
- Calculate the present value of \$89,000 to be received in 15 years, assuming an opportunity cost of 14 percent.
Answer: $PV = 89,000(1.40) = \$12,460$
 Level of Difficulty: 1
 Learning Goal: 2
 Topic: Future Value (Equation 4.9, 4.11, and 4.12)
- Jeanie has deposited \$33,000 today in an account which will earn 10 percent annually. She plans to leave the funds in this account for seven years earning interest. If the goal of this deposit is to cover a future obligation of \$65,000, what recommendation would you make to Jeanie?
Answer: $FV = 33,000(1.949) = \$64,317$
 Jeanie will only have \$64,317 at the end of seven years under the stated arrangement. She must find an account with a higher interest rate or deposit a larger sum today.
 Level of Difficulty: 2
 Learning Goal: 2
 Topic: Future Value (Equation 4.4, 4.5, and 4.6)
- EcoSystems, Inc. is preparing a five-year plan. Today, sales are \$1,000,000. If the growth rate in sales is projected to be 10 percent over the next five years, what will the dollar amount of sales be in year five?
Answer: $FV = 1,000,000(1.611) = \$1,611,000$
 Level of Difficulty: 2
 Learning Goal: 2
 Topic: Future Value (Equation 4.4, 4.5, and 4.6)

5. Fred has inherited \$6,000 from the death of Barney. He would like to use this money to buy Wilma a new rockmobile costing \$7,000 for their 10th anniversary celebration which will take place in 2 years from now. Will Fred have enough money to buy the gift if he deposits his money in an account paying 8 percent compounded semi-annually?

Answer: $n = 2$, $m = 2$, $i = 8\%$

$$FV = PV(FVIF_{4\%,4}) = 6,000(1.170) = \$7,020$$

Yes, Fred will have enough money to buy the rockmobile.

Level of Difficulty: 2

Learning Goal: 2

Topic: Future Value (Equation 4.4, 4.5, and 4.6)

6. Kay and Arthur are newlyweds and have just purchased a condominium for \$70,000. Since the condo is very small, they hope to move into a single-family house in 5 years. How much will their condo worth in 5 years if inflation is expected to be 8 percent?

Answer: $PV = \$70,000$, $i = 8\%$, $n = 5$

$$FV = PV(FVIF) = 70,000(1.469) = \$102,830.$$

Level of Difficulty: 2

Learning Goal: 2

Topic: Future Value (Equation 4.4, 4.5, and 4.6)

7. Calculate the present value of a \$10,000 perpetuity at a 6 percent discount rate.

Answer: $PV = 10,000/0.06 = \$166,667$

Level of Difficulty: 1

Learning Goal: 3

Topic: Perpetuities (Equation 4.19)

8. Calculate the future value of an annuity of \$5,000 each year for eight years, deposited at 6 percent.

Answer: $FV = 5,000(9.897) = \$49,485$

Level of Difficulty: 2

Learning Goal: 3

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

9. Calculate the present value of an annuity of \$3,900 each year for four years, assuming an opportunity cost of 10 percent.

Answer: $PV = 3,900(3.170) = \$12,363$

Level of Difficulty: 2

Learning Goal: 3

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

10. Linda has decided to set up an account that will pay her granddaughter (Janice) \$5,000 a year indefinitely. How much should Linda deposit in an account paying 8 percent annual interest?

Answer: $PV = 5,000/0.08 = \$62,500$

Level of Difficulty: 2

Learning Goal: 3

Topic: Present Value of an Annuity (Equation 4.13, 4.14)

11. A wealthy industrialist wishes to establish a \$2,000,000 trust fund which will provide income for his grandchild into perpetuity. He stipulates in the trust agreement that the principal may not be distributed. The grandchild may only receive the interest earned. If the interest rate earned on the trust is expected to be at least 7 percent in all future periods, how much income will the grandchild receive each year?

Answer: $\$2,000,000 \times 0.07 = \$140,000$

Level of Difficulty: 2

Learning Goal: 3

Topic: Perpetuities (Equation 4.19)

12. Cara establishes a seven-year, 8 percent loan with a bank requiring annual end-of-year payments of \$960.43. Calculate the original principal amount.

Answer: $PVA = 960.43(5.206) = \$5,000$

Level of Difficulty: 2

Learning Goal: 3

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

13. A lottery administrator has just completed the state's most recent \$50 million lottery. Receipts from lottery sales were \$50 million and the payout will be \$5 million at the end of each year for 10 years. The expenses of running the lottery were \$800,000. The state can earn an annual compound rate of 8 percent on any funds invested.

(a) Calculate the gross profit to the state from this lottery.

(b) Calculate the net profit to the state from this lottery (no taxes).

Answers:

Lottery revenue	\$50,000,000
Less: Cost of payout	
$\$5,000,000 \times 6.710$	33,550,000
Gross profit	\$16,450,000
(a) Less: operating expenses	800,000
(b) Net profit	\$15,650,000

Level of Difficulty: 3

Learning Goal: 3

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

14. Kimberly has just won a \$20 million lottery, which will pay her \$1 million at the end of each year for 20 years. An investor has offered her \$10 million for this annuity. She estimates that she can earn 10 percent interest, compounded annually, on any amounts she invests. She asks your advice on whether to accept or reject the offer. What will you tell her? (Ignore Taxes)

Answer: $P = \$1,000,000 \times 8.514 = \$8,514,000$

$\$10,000,000 > \$8,514,000$ Accept the offer.

Level of Difficulty: 3

Learning Goal: 3

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

15. Mr. Handyman has been awarded a bonus for his outstanding work. His employer offers him a choice of a lump-sum of \$5,000 today, or an annuity of \$1,250 a year for the next five years. Which option should Mr. Handyman choose if his opportunity cost is 9 percent?

Answer: $PVA = \$1,250(PVIFA) = 1,250(3.890) = \$4,862.50$

Mr. Handyman should choose a lump-sum of \$5,000 today.

Level of Difficulty: 3

Learning Goal: 3

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

16. In their meeting with their advisor, Mr. & Mrs. Smith concluded that they would need \$40,000 per year during their retirement years in order to live comfortably. They will retire 10 years from now and expect a 20-year retirement period. How much should Mr. & Mrs. Smith deposit now in a bank account paying 9 percent to reach financial happiness during retirement?

Answer: The amount of money required at the beginning of the retirement period is:

$$n = 20, i = 9\%$$

$$PVA = PMT(PVIFA) = 40,000(9.129) = \$365,160$$

$$n = 10, i = 9\%$$

$$PV = 365,160(0.422) = \$154,097.52$$

Level of Difficulty: 3

Learning Goal: 3

Topic: Complex Time Value Problems (Equation 4.13, 4.14, and 4.15, 4.16)

17. Jay is 30 years old and will retire at age 65. He will receive retirement benefits but the benefits are not going to be enough to make a comfortable retirement life for him. Jay has estimated that an additional \$25,000 a year over his retirement benefits will allow him to have a satisfactory life. How much should Jay deposit today in an account paying 6 percent interest to meet his goal? Assume Jay will have 15 years of retirement.

Answer: $PMT = \$25,000, n = 15, i = 6\%$

$$P(65) = 25,000(PVIFA) = 25,000(9.712) = \$242,800$$

$$FV = \$242,800, n = 35, i = 6\%$$

$$P(30) = 242,800(PVIF) = 242,800(0.130) = \$31,564$$

Level of Difficulty: 4

Learning Goal: 3

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6 and 4.15, 4.16)

18. You have been given a choice between two retirement policies as described below.
Policy A: You will receive equal annual payments of \$10,000 beginning 35 years from now for 10 years.

Policy B: You will receive one lump-sum of \$100,000 in 40 years from now.

Which policy would you choose? Assume rate of interest is 6 percent.

Answer: Policy A: present value of the annuity at the beginning of the 35 years from now:

$$PVA = PMT(PVIFA) = 10,000(7.360) = \$73,600$$

Policy B: present value of the lump-sum at the beginning of the 35 years from now:

$$PV = FV(PVIF) = 100,000(0.747) = \$74,700$$

I will choose policy B.

Level of Difficulty: 4

Learning Goal: 3

Topic: Complex Time Value Problems (Equation 4.9, 4.11, 4.12 and 4.15, 4.16)

19. During her four years at college, Rose received the following amounts of money at the end of each year from her grandmother. She deposited her money in a saving account paying 6 percent rate of interest. How much money will Rose have on graduation day?

Year	\$
1	100
2	200
3	300
4	400

Answer:

Year	\$	n	FVIF	FV
1	\$100	3	1.191	\$119.10
2	200	2	1.124	224.80
3	300	1	1.060	318.00
4	400	0	1.000	400.00
				<u>\$1,061.90</u>

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.4, 4.5, 4.6)

20. You have provided your friend with a service worth \$8,500. Your friend offers you the following cash flow instead of paying \$8,500 today. Should you accept his offer if your opportunity cost is 8 percent?

Year	Cash Flow
1	\$4,000
2	3,000
3	2,000
4	1,000

Answer:

Year	Cash Flow	PVIF	PV
1	\$4,000	0.926	\$3,704
2	3,000	0.857	2,571
3	2,000	0.794	1,588
4	1,000	0.735	735
			<u>\$8,598</u>

Accept the offer.

Level of Difficulty: 2

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12)

21. Calculate the present value of \$5,800 received at the end of year 1, \$6,400 received at the end of year 2, and \$8,700 at the end of year 3, assuming an opportunity cost of 13 percent.
- Answer:** $PV = 5,800(0.885) + 6,400(0.783) + 8,700(0.693) = \$16,173.30$
- Level of Difficulty: 2
Learning Goal: 4
Topic: Mixed Streams (Equation 4.9, 4.11, 4.12)
22. Calculate the present value of \$800 received at the beginning of year 1, \$400 received at the beginning of year 2, and \$700 received at the beginning of year 3, assuming an opportunity cost of 9 percent.
- Answer:** $PV = 800 + 400(0.917) + 700(0.842) = \$1,756.20$
- Level of Difficulty: 2
Learning Goal: 4
Topic: Mixed Streams (Equation 4.9, 4.11, 4.12)
23. Calculate the combined future value at the end of year 3 of \$1,000 received at the end of year 1, \$3,000 received at the end of year 2, and \$5,000 received at the end of year 3, all sums deposited at 5 percent.
- Answer:** $FV = 1000(1.102) + 3000(1.050) + 5000 = \$9,252$
- Level of Difficulty: 2
Learning Goal: 4
Topic: Mixed Streams (Equation 4.4, 4.5, 4.6)
24. You are considering the purchase of new equipment for your company and you have narrowed down the possibilities to two models which perform equally well. However, the method of paying for the two models is different. Model A requires \$5,000 per year payment for the next five years. Model B requires the following payment schedule. Which model should you buy if your opportunity cost is 8 percent?

Year	Payment (Model B)
1	\$7,000
2	6,000
3	5,000
4	4,000
5	3,000

Answer: Model A: $PV = PMT (PVIFA) = 5,000 (3.993) = \$19,965$

Model B			
Year	Payment	PVIF	PV
1	\$7,000	0.926	\$6,482
2	6,000	0.857	5,142
3	5,000	0.794	3,970
4	4,000	0.735	2,940
5	3,000	0.681	2,043
			\$20,577

Buy Model A.

Level of Difficulty: 3

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12 and 4.15, 4.16)

25. Last Christmas, Larry received an annual bonus of \$1,500. These annual bonuses are expected to grow by 5 percent for the next 5 years. How much will Larry have at the end of the fifth year if he invests his Christmas bonuses (including the most recent bonus) in a project paying 8 percent per year?

Answer:

Year	Bonus ₀	FVIF _(5%, t)	Bonus(t)	n	FVIF _(8%, n)	FV
0	\$1,500	1.000	\$1,500	5	1.469	\$2,203.50
1	1,500	1.050	1,575	4	1.360	2,142.00
2	1,500	1.102	1,653	3	1.260	2,082.78
3	1,500	1.158	1,737	2	1.166	2,025.34
4	1,500	1.216	1,824	1	1.080	1,969.92
5	1,500	1.276	1,914	0	1.000	1,914.00
						\$12,337.54

Level of Difficulty: 4

Learning Goal: 4

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6)

26. Calculate the present value of the following stream of cash flows, assuming that the firm's opportunity cost is 15 percent.

Years	Amount
1–7	\$12,000
8–10	14,000

Answer: $PV = 12,000(4.160) + 14,000(5.019 - 4.160) = \$61,946$

Level of Difficulty: 4

Learning Goal: 4

Topic: Mixed Streams (Equation 4.9, 4.11, 4.12 and 4.15, 4.16)

27. Calculate the future value of \$6,490 received today and deposited for five years in an account which pays interest of 14 percent compounded semiannually.

Answer: $FV = 6,490(1.967) = \$12,766$

Level of Difficulty: 2

Learning Goal: 5

Topic: Future Value (Equation 4.4, 4.5, 4.6)

28. Calculate the future value of \$10,000 received today and deposited for six years in an account which pays interest of 12 percent compounded quarterly.

Answer: $FV = 10,000(2.033) = \$20,330$

Level of Difficulty: 3

Learning Goal: 5

Topic: Future Value (Equation 4.4, 4.5, 4.6)

29. Jeanne has just graduated from high school and has received an award for \$5,000. She would like to deposit the money in an interest earning account until she graduates from college (i.e., four years from now). In her search for the highest interest earning account, she has narrowed the list down to the following two accounts: 1) bank A pays 9 percent interest compounded annually, and 2) bank B pays 8 percent interest compounded semi-annually. Which is the better offer, and how much will Jeanne have upon graduation from college?

Answer: Bank A: $n = 4, i = 9\%, m = 1$

$FV = 5,000(1.412) = \$7,060$

Bank B: $n = 4, i = 8\%, m = 2$

$FV = 5,000(1.369) = \$6,845$

Jeanne should deposit her money in Bank A and she will have \$7,060 upon her graduation from college.

Level of Difficulty: 3

Learning Goal: 5

Topic: Nominal and Effective Interest Rates (Equation 4.23)

30. Janice borrows \$25,000 from the bank at 15 percent to be repaid in 10 equal annual installments. Calculate the end-of-year payment.

Answer: $PMT = 25,000/5.019 = \$4,981.07$

Level of Difficulty: 2

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

31. The following table presents the Sally's Silly Service Company's net earnings for the past six years. Compute the growth rate in the company's earnings.

Year	Return
2002	\$2,659
2001	2,500
2000	2,370
1999	2,100
1998	1,890
1997	1,728

Answer: $FVIF = FV/PV = 2,659/1,728 = 1.539$ $n = 5, i = 9\%$

Level of Difficulty: 2

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6 or 4.9, 4.11, 4.12)

32. Marc has purchased a new car for \$15,000. He paid \$2,500 as down payment and he paid the balance by a loan from his hometown bank. The loan is to be paid on a monthly basis for two years charging 12 percent interest. How much are the monthly payments?

Answer: $PV = 15,000 - 2,500 = \$12,500, i = 12\%, n = 2, m = 12$

$$PMT = PVA/PVIFA = 12,500/21.244 = \$588.40$$

Level of Difficulty: 2

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

33. You have been given the opportunity to earn \$20,000 five years from now if you invest \$9,524 today. What will be the rate of return to your investment?

Answer: $FVIF = 20,000/9,524 = 2.10$ $i = 16\%$.

Level of Difficulty: 2

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6 or 4.9, 4.11, 4.12)

34. Ten years ago, Tom purchased a painting for \$300. The painting is now worth \$1,020. Tom could have deposited \$300 in a savings account paying 12 percent interest compounded annually. Which of these two options would have provided Tom with a higher return?

Answer: $PV = \$300, FV = \$1,020, n = 10$

$$FVIF = 1,020/300 = 3.40 \quad i = 13\%$$

Painting has a higher return (13 percent) in comparison to the 12 percent rate of return from the savings account.

Level of Difficulty: 2

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6 or 4.9, 4.11, 4.12)

35. Find the equal annual end-of-year payment on \$50,000, 15 year, and 10 percent loan.

Answer: $PMT = PVA/PVIFA = 50,000/7.606 = \$6,573.76$

Level of Difficulty: 2

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

36. A firm wishes to establish a fund which, in 10 years, will accumulate to \$10,000,000. The fund will be used to repay an outstanding bond issue. The firm plans to make deposits, which will earn 12 percent, to this fund at the end of each of the 10 years prior to maturity of the bond. How large must these deposits be to accumulate to \$10,000,000?

Answer: $PMT = 10,000,000/17.549 = \$569,833.04$

Level of Difficulty: 3

Learning Goal: 6

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

37. John borrowed \$12,000 to buy a new car and expects to pay \$564.87 per month for the next 2 years to pay off the loan. What is the loan's rate of interest?

Answer: $PVA = \$12,000$, $PMT = \$564.87$, $n = 2$, $m = 12$

$$PVIFA = PVA/PMT = 12,000/564.87 = 21.244 \quad i/m = 1\% \quad i = 12\%$$

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

38. The New York Soccer Association would like to accumulate \$10,000 by the end of 4 years from now to finance a big soccer weekend for its members. The Association currently has \$2,500 and wishes to raise the balance by arranging annual fund-raising events. How much money should they raise at each annual fund-raising event assuming 8 percent rate of interest?

Answer: Future value of \$2,500 at the end of fourth year:

$$FV = 2,500(1.360) = \$3,400$$

$$\text{Balance} = 10,000 - 3,400 = \$6,600$$

$$PMT = FVA/FVIFA = 6,600/4.506 = \$1,464.71$$

Level of Difficulty: 3

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6 and 4.13, 4.14)

39. Ms. Day needs \$20,000 to buy her dream car. In her search for the best (low cost) loan, she has gathered the following information from three local banks. Which bank would you recommend Ms. Day borrow from?

Bank	Annual Payment	Term (years)
A	\$8,326.40	3
B	6,309.15	4
C	5,411.25	5

Answer: A: $PVIFA = 20,000/8,326.40 = 2.402 \quad i = 12\%$

B: $PVIFA = 20,000/6,309.15 = 3.170 \quad i = 10\%$

C: $PVIFA = 20,000/5,411.25 = 3.696 \quad i = 11\%$

Ms. Day should borrow from Bank B. Bank B has the lowest rate.

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

40. A deep-discount bond can be purchased for \$312 and in 20 years it will be worth \$1,000. What is the rate of interest on the bond?

Answer: $FVIF = 1,000/312 = 3.205$ $i = 6\%$

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6 or 4.9, 4.11, 4.12)

41. Timothy borrows \$6,930 from the bank. For a four-year loan, the bank requires annual end-of-year payments of \$2,281.86. Calculate the interest rate on the loan.

Answer: $PVIFA = 6,930/2,281.86 = 3.037$, $i = 12\%$

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.15, 4.16)

42. Tom is evaluating the growth rate in dividends of a company over the past 6 years. What is the annual compound growth rate if the dividends are as follows:

Year	Dividends
1997	\$1.38
1998	1.52
1999	1.85
2000	1.80
2001	1.95
2002	2.15

Answer: $\$2.15/\$1.38 = 1.558 = FVIF_{5\text{years}}$ or
 $\$1.38/\$2.15 = 0.6419 = PVIF_{5\text{years}}$
 approximately 9 percent.

Level of Difficulty: 3

Learning Goal: 6

Topic: Finding Interest or Growth Rates (Equation 4.4, 4.5, 4.6 or 4.9, 4.11, 4.12)

43. To expand its operation, the International Tools Inc. (ITI) has applied for a \$3,500,000 loan from the International Bank. According to ITI's financial manager, the company can only afford a maximum yearly loan payment of \$1,000,000. The bank has offered ITI, 1) a 3-year loan with a 10 percent interest rate, 2) a 4-year loan with a 11 percent interest rate, or 3) a 5-year loan with a 12 percent interest rate.

(a) Compute the loan payment under each option.

(b) Which option should the company choose?

Answers:(a)

1) $PMT = 3,500,000/2.487 = \$1,407,318.05$

2) $PMT = 3,500,000/3.102 = \$1,128,304.32$

3) $PMT = 3,500,000/3.605 = \$970,873.79$

(b) The company should choose option #3.

Level of Difficulty: 3

Learning Goal: 6

Topic: Present Value of an Annuity (Equation 4.15, 4.16)

44. To buy his favorite car, Larry is planning to accumulate money by investing his Christmas bonuses for the next five years in a security which pays a 10 percent annual rate of return. The car will cost \$20,000 at the end of the fifth year and Larry's Christmas bonus is \$3,000 a year. Will Larry accumulate enough money to buy the car?

Answer: $FVA = PMT (FVIFA) = 3,000(6.105) = \$18,315$

Larry will not have enough money to buy the car. He should either invest more money or deposit his Christmas bonuses in a security paying a higher rate of return.

Level of Difficulty: 3

Learning Goal: 6

Topic: Future Value of an Annuity (Equation 4.13, 4.14)

45. Mr. & Mrs. Pribel wish to purchase a boat in 8 years when they retire. They are planning to purchase the boat using proceeds from the sale of their property which is currently worth \$90,000 and its value is growing at 7 percent a year. The boat is currently worth \$200,000 increasing at 5 percent per year. In addition to the value of their property, how much additional money should they deposit at the end of each year in an account paying 9 percent annual interest in order to be able to buy the boat upon retirement?

Answer: Value of the property upon retirement:

$$PV = \$90,000, i = 7\%, n = 8$$

$$FV = PV(FVIF) = 90,000(1.718) = \$154,620$$

Value of the boat upon retirement:

$$PV = \$200,000, i = 5\%, n = 8$$

$$FV = PV(FVIF) = 200,000(1.477) = \$295,400$$

Additional money needed upon retirement:

$$\$295,400 - \$154,620 = \$140,780$$

Amount of money needed to deposit at the end of each year:

$$FV = \$140,780, n = 8, i = 9\%, PMT = ?$$

$$PMT = FV/FVIFA = 140,780/11.028 = \$12,765.69$$

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6 and 4.13, 4.14)

46. Herbert has opened a retirement fund account which pays 7 percent interest and requires \$5,000 annual deposits. Herbert will retire in 15 years and expects 10 years of retirement life. What is the maximum annual retirement benefit Herbert can get during his retirement years?

Answer: $i = 7\%, PMT = \$5,000, n = 15$

At the beginning of retirement:

$$FVA = 5,000(FVIFA) = 5,000(25.129) = \$125,645$$

Annual retirement benefit: $i = 7\%, n = 10, P = \$125,645$

$$PMT = PVA/PVIFA = 125,645/7.024 = \$17,887.96$$

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.13, 4.14 and 4.15, 4.16)

47. Brian borrows \$5,000 from a bank at 8 percent annually compounded interest to be repaid in five annual installments. Calculate the principal paid in the third year.

Answer: $PMT = 5,000/3.993 = \$1,252.19$

Year	Payment	Principal	Interest	Balance
0	0	\$5,000.00		
1	\$1,252.19	\$852.19	\$ 400.00	4,147.81
2	1,252.19	920.37	331.83	3,227.44
3	1,252.19	993.99	258.20	

The principal paid in the third year is \$993.99

Level of Difficulty: 4

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

48. Nancy would like to accumulate \$10,000 by the end of 3 years from now to buy a sports car from her friend, Jim. She has \$2,500 now and would like to save equal annual end-of-year deposits to pay for the car. How much should she deposit at the end of each year in an account paying 8 percent interest to buy the car?

Answer: Future value of \$2,500 at the end of year 3:

$$FV = 2,500(FVIF) = 2,500(1.260) = \$3,150$$

$$\text{Balance} = 10,000 - 3,150 = \$6,850$$

$$PMT = FVA/FVIFA = 6,850/3.246 = \$2,110.29$$

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6 and 4.13, 4.14)

49. To expand its operation, International Tools Inc. has applied to the International Bank for a 3-year, \$3,500,000 loan. Prepare a loan amortization table assuming 10 percent rate of interest.

Answer: $PMT = 3,500,000/2.487 = \$1,407,318.05$

Year	Payment	Principal	Interest	Balance
0	0	\$3,500,000.00		
1	\$1,407,318.05	\$1,057,318.05	\$ 350,000.00	2,442,681.95
2	1,407,318.05	1,163,049.85	244,268.20	1,279,632.10
3	1,407,318.05	1,279,354.84	127,963.21	

Level of Difficulty: 4

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

50. Ken borrows \$15,000 from a bank at 10 percent annually compounded interest to be repaid in six equal installments. Calculate the interest paid in the second year.

Answer: $PMT = 15,000/4.355 = \$3,444.32$

Year	Payment	Principal	Interest	Balance
0	0	\$ 15,000		
1	\$3,444.32	\$1,944.32	\$1,500.00	13,055
2	3,444.32	1,305.57		

The interest paid in the second year is \$1,305.57

Level of Difficulty: 4

Learning Goal: 6

Topic: Loan Amortization (Equation 4.15, 4.16)

51. Suzy wants to buy a house but does not want to get a loan. The average price of her dream house is \$500,000 and its price is growing at 5 percent per year. How much should Suzy invest at the end of each year for the next 5 years in order to accumulate enough money to buy her dream house with cash at the end of the fifth year? Assume the project pays 12 percent rate of return.

Answer: $FV = 500,000(1.276) = \$638,000$

$PMT = 638,000/6.353 = \$100,425$

Level of Difficulty: 4

Learning Goal: 6

Topic: Complex Time Value Problems (Equation 4.4, 4.5, 4.6 and 4.13, 4.14)

52. Assume you have a choice between two deposit accounts. Account X has an annual percentage rate of 12.25 percent but with interest compounded monthly. Account Y has an annual percentage rate of 12.20 percent with interest compounded continuously. Which account provides the highest effective annual return?

Answer: *Account X*

$EAR = [1 + (0.1225/12)^{12} - 1 = 12.96\%$

Account Y

$EAR = e^{0.12} - 1 = 12.75\%$

Choose X

Level of Difficulty: 4

Learning Goal: 5

Topic: Continuous Compounding and Effective Annual Rate (Equation 4.21, 4.22, 4.23)

53. Congratulations! You have just won the lottery! However, the lottery bureau has just informed you that you can take your winnings in one of two ways. Choice X pays \$1,000,000. Choice Y pays \$1,750,000 at the end of five years from now. Using a discount rate of 5 percent, based on present values, which would you choose? Using the same discount rate of 5 percent, based on future values, which would you choose? What do your results suggest as a general rule for approaching such problems? (Make your choices based purely on the time value of money.)

Answer: The PV of A = \$1,000,000; The PV of B = \$1,371,000; The FV of A = \$1,276,000; The FV of B = \$1,500,000. Based on both present values and future values, B is the better choice. The student should recognize that finding present values and finding future values are simply reverse processes of one another, and that choosing between two lump sums based on PV will always give the same result as choosing between the same two lump sums based on FV.

Level of Difficulty: 2

Learning Goal: 2

Topic: Present Value and Future Value (Equation 4.4, 4.5, 4.6, 4.9, 4.11, 4.12)

54. Nico is the new assistant branch manager of a larger Florida-based bank and the branch manager has asked him a question to test his knowledge. The question he asked is which rate should the bank advertise on monthly-compounded loans, the nominal annual percentage rate or the effective annual percentage rate? Which rate should the bank advertise on quarterly-compounded savings accounts? Explain. As a consumer, which would you prefer to see and why?

Answer: A bank would rather advertise the annual percentage rate on loans since this rate appears to be lower and the effective annual rate. With respect to savings accounts, the bank would rather advertise the effective rate since this rate will be higher than the annual percentage rate with compounding frequency greater than annually. As a consumer, the effective rate is the more important rate since it represents the rate actually paid or earned.

Level of Difficulty: 3

Learning Goal: 5

Topic: Nominal and Effective Interest Rates (Equation 4.23)