5. **Time Value** On subsidized Stafford loans, a common source of financial aid for college students, interest does not begin to accrue until repayment begins. Who receives a bigger subsidy, a freshman or a senior? Explain.

Use the following information to answer the next five questions:

Toyota Motor Credit Corporation (TMCC), a subsidiary of Toyota Motor Corporation, offered some securities for sale to the public on March 28, 2008. Under the terms of the deal, TMCC promised to repay the owner of one of these securities $100,000 on March 28, 2038, but investors would receive nothing until then. Investors paid TMCC $24,099 for each of these securities; so they gave up $24,099 on March 28, 2008, for the promise of a $100,000 payment 30 years later.

6. **Time Value of Money** Why would TMCC be willing to accept such a small amount today ($24,099) in exchange for a promise to repay about four times that amount ($100,000) in the future?

7. **Call Provisions** TMCC has the right to buy back the securities on the anniversary date at a price established when the securities were issued (this feature is a term of this particular deal). What impact does this feature have on the desirability of this security as an investment?

8. **Time Value of Money** Would you be willing to pay $24,099 today in exchange for $100,000 in 30 years? What would be the key considerations in answering yes or no? Would your answer depend on who is making the promise to repay?

9. **Investment Comparison** Suppose that when TMCC offered the security for $24,099 the U.S. Treasury had offered an essentially identical security. Do you think it would have had a higher or lower price? Why?

10. **Length of Investment** The TMCC security is bought and sold on the New York Stock Exchange. If you looked at the price today, do you think the price would exceed the $24,099 original price? Why? If you looked in the year 2019, do you think the price would be higher or lower than today's price? Why?

Questions and Problems: connect™

BASIC (Questions 1–20)

1. **Simple Interest versus Compound Interest** First City Bank pays 9 percent simple interest on its savings account balances, whereas Second City Bank pays 9 percent interest compounded annually. If you made a $5,000 deposit in each bank, how much more money would you earn from your Second City Bank account at the end of 10 years?

2. **Calculating Future Values** Compute the future value of $1,000 compounded annually for

    1. 10 years at 6 percent.
    2. 10 years at 9 percent.
    3. 20 years at 6 percent.
    4. Why is the interest earned in part (c) not twice the amount earned in part (a)?

3. **Calculating Present Values** For each of the following, compute the present value:

Present Value	Years	Interest Rate	Future Value
	6	7%	$ 15,451
	9	15	51,557
	18	11	886,073
	23	18	550,164

4. **Calculating Interest Rates** Solve for the unknown interest rate in each of the following:

Present Value	Years	Interest Rate	Future Value
$ 242	2		$ 307
410	9		896
51,700	15		162,181
18,750	30		483,500

5. **Calculating the Number of Periods** Solve for the unknown number of years in each of the following:

Present Value	Years	Interest Rate	Future Value
$ 625		6%	$ 1,284
810		13	4,341
18,400		32	402,662
21,500		16	173,439

6. **Calculating the Number of Periods** At 9 percent interest, how long does it take to double your money? To quadruple it?

7. **Calculating Present Values** Imprudential, Inc., has an unfunded pension liability of $750 million that must be paid in 20 years. To assess the value of the firm's stock, financial analysts want to discount this liability back to the present. If the relevant discount rate is 8.2 percent, what is the present value of this liability?

8. **Calculating Rates of Return** Although appealing to more refined tastes, art as a collectible has not always performed so profitably. During 2003, Sotheby's sold the Edgar Degas bronze sculpture Petite Danseuse de Quartorze Ans at auction for a price of $10,311,500. Unfortunately for the previous owner, he had purchased it in 1999 at a price of $12,377,500. What was his annual rate of return on this sculpture?

9. **Perpetuities** An investor purchasing a British consol is entitled to receive annual payments from the British government forever. What is the price of a consol that pays $120 annually if the next payment occurs one year from today? The market interest rate is 5.7 percent.

10. **Continuous Compounding** Compute the future value of $1,900 continuously compounded for

   1. 5 years at a stated annual interest rate of 12 percent.
   2. 3 years at a stated annual interest rate of 10 percent.
   3. 10 years at a stated annual interest rate of 5 percent.
   4. 8 years at a stated annual interest rate of 7 percent.

11. **Present Value and Multiple Cash Flows** Conoly Co. has identified an investment project with the following cash flows. If the discount rate is 10 percent, what is the present value of these cash flows? What is the present value at 18 percent? At 24 percent?

Year	Cash Flow
1	$1,200
2	730
3	965
4	1,590

12. **Present Value and Multiple Cash Flows** Investment X offers to pay you $5,500 per year for nine years, whereas Investment Y offers to pay you $8,000 per year for five years. Which of these cash flow streams has the higher present value if the discount rate is 5 percent? If the discount rate is 22 percent?

13. **Calculating Annuity Present Value** An investment offers $4,300 per year for 15 years, with the first payment occurring one year from now. If the required return is 9 percent, what is the value of the investment? What would the value be if the payments occurred for 40 years? For 75 years? Forever?

14. **Calculating Perpetuity Values** The Perpetual Life Insurance Co. is trying to sell you an investment policy that will pay you and your heirs $20,000 per year forever. If the required return on this investment is 6.5 percent, how much will you pay for the policy? Suppose the Perpetual Life Insurance Co. told you the policy costs $340,000. At what interest rate would this be a fair deal?

15. **Calculating EAR** Find the EAR in each of the following cases:

Stated Rate (APR)	Number of Times Compounded	Effective Rate (EAR)
8%	Quarterly	
18	Monthly	
12	Daily	
14	Infinite	

16. **Calculating APR** Find the APR, or stated rate, in each of the following cases:

Stated Rate (APR)	Number of Times Compounded	Effective Rate (EAR)
	Semiannually	10.3%
	Monthly	9.4
	Weekly	7.2
	Infinite	15.9

17. **Calculating EAR** First National Bank charges 10.1 percent compounded monthly on its business loans. First United Bank charges 10.4 percent compounded semiannually. As a potential borrower, to which bank would you go for a new loan?

18. **Interest Rates** Well-known financial writer Andrew Tobias argues that he can earn 177 percent per year buying wine by the case. Specifically, he assumes that he will consume one $10 bottle of fine Bordeaux per week for the next 12 weeks. He can either pay $10 per week or buy a case of 12 bottles today. If he buys the case, he receives a 10 percent discount and, by doing so, earns the 177 percent. Assume he buys the wine and consumes the first bottle today. Do you agree with his analysis? Do you see a problem with his numbers?

19. **Calculating Number of Periods** One of your customers is delinquent on his accounts payable balance. You've mutually agreed to a repayment schedule of $600 per month. You will charge .9 percent per month interest on the overdue balance. If the current balance is $18,400, how long will it take for the account to be paid off?

20. **Calculating EAR** Friendly's Quick Loans, Inc., offers you "three for four or I knock on your door." This means you get $3 today and repay $4 when you get your paycheck in one week (or

else). What's the effective annual return Friendly's earns on this lending business? If you were brave enough to ask, what APR would Friendly's say you were paying?

INTERMEDIATE (Questions 21–50)

21. **Future Value** What is the future value in seven years of $1,000 invested in an account with a stated annual interest rate of 8 percent,

    1. Compounded annually?
    2. Compounded semiannually?
    3. Compounded monthly?
    4. Compounded continuously?
    5. Why does the future value increase as the compounding period shortens?

22. **Simple Interest versus Compound Interest** First Simple Bank pays 6 percent simple interest on its investment accounts. If First Complex Bank pays interest on its accounts compounded annually, what rate should the bank set if it wants to match First Simple Bank over an investment horizon of 10 years?

23. **Calculating Annuities** You are planning to save for retirement over the next 30 years. To do this, you will invest $700 a month in a stock account and $300 a month in a bond account. The return of the stock account is expected to be 10 percent, and the bond account will pay 6 percent. When you retire, you will combine your money into an account with an 8 percent return. How much can you withdraw each month from your account assuming a 25-year withdrawal period?

24. **Calculating Rates of Return** Suppose an investment offers to quadruple your money in 12 months (don't believe it). What rate of return per quarter are you being offered?

25. **Calculating Rates of Return** You're trying to choose between two different investments, both of which have up-free costs of $75,000. Investment G returns $135,000 in six years. Investment H returns $195,000 in 10 years. Which of these investments has the higher return?

26. **Growing Perpetuities** Mark Weinstein has been working on an advanced technology in laser eye surgery. His technology will be available in the near term. He anticipates his first annual cash flow from the technology to be $215,000, received two years from today. Subsequent annual cash flows will grow at 4 percent in perpetuity. What is the present value of the technology if the discount rate is 10 percent?

27. **Perpetuities** A prestigious investment bank designed a new security that pays a quarterly dividend of $5 in perpetuity. The first dividend occurs one quarter from today. What is the price of the security if the stated annual interest rate is 7 percent, compounded quarterly?

28. **Annuity Present Values** What is the present value of an annuity of $5,000 per year, with the first cash flow received three years from today and the last one received 25 years from today? Use a discount rate of 8 percent.

29. **Annuity Present Values** What is the value today of a 15-year annuity that pays $750 a year? The annuity's first payment occurs six years from today. The annual interest rate is 12 percent for years 1 through 5, and 15 percent thereafter.

30. **Balloon Payments** Audrey Sanborn has just arranged to purchase a $450,000 vacation home in the Bahamas with a 20 percent down payment. The mortgage has a 7.5 percent stated annual

interest rate, compounded monthly, and calls for equal monthly payments over the next 30 years. Her first payment will be due one month from now. However, the mortgage has an eight-year balloon payment, meaning that the balance of the loan must be paid off at the end of year 8. There were no other transaction costs or finance charges. How much will Audrey's balloon payment be in eight years?

31. **Calculating Interest Expense** You receive a credit card application from Shady Banks Savings and Loan offering an introductory rate of 2.40 percent per year, compounded monthly for the first six months, increasing thereafter to 18 percent compounded monthly. Assuming you transfer the $6,000 balance from your existing credit card and make no subsequent payments, how much interest will you owe at the end of the first year?

32. **Perpetuities** Barrett Pharmaceuticals is considering a drug project that costs $150,000 today and is expected to generate end-of-year annual cash flows of $13,000, forever. At what discount rate would Barrett be indifferent between accepting or rejecting the project?

33. **Growing Annuity** Southern California Publishing Company is trying to decide whether to revise its popular textbook, Financial Psychoanalysis Made Simple. The company has estimated that the revision will cost $65,000. Cash flows from increased sales will be $18,000 the first year. These cash flows will increase by 4 percent per year. The book will go out of print five years from now. Assume that the initial cost is paid now and revenues are received at the end of each year. If the company requires an 11 percent return for such an investment, should it undertake the revision?

34. **Growing Annuity** Your job pays you only once a year for all the work you did over the previous 12 months. Today, December 31, you just received your salary of $60,000, and you plan to spend all of it. However, you want to start saving for retirement beginning next year. You have decided that one year from today you will begin depositing 5 percent of your annual salary in an account that will earn 9 percent per year. Your salary will increase at 4 percent per year throughout your career. How much money will you have on the date of your retirement 40 years from today?

35. **Present Value and Interest Rates** What is the relationship between the value of an annuity and the level of interest rates? Suppose you just bought a 12-year annuity of $7,500 per year at the current interest rate of 10 percent per year. What happens to the value of your investment if interest rates suddenly drop to 5 percent? What if interest rates suddenly rise to 15 percent?

36. **Calculating the Number of Payments** You're prepared to make monthly payments of $250, beginning at the end of this month, into an account that pays 10 percent interest compounded monthly. How many payments will you have made when your account balance reaches $30,000?

37. **Calculating Annuity Present Values** You want to borrow $80,000 from your local bank to buy a new sailboat. You can afford to make monthly payments of $1,650, but no more. Assuming monthly compounding, what is the highest APR you can afford on a 60-month loan?

38. **Calculating Loan Payments** You need a 30-year, fixed-rate mortgage to buy a new home for $250,000. Your mortgage bank will lend you the money at a 6.8 percent APR for this 360-month loan. However, you can only afford monthly payments of $1,200, so you offer to pay off any remaining loan balance at the end of the loan in the form of a single balloon payment. How large will this balloon payment have to be for you to keep your monthly payments at $1,200?

39. **Present and Future Values** The present value of the following cash flow stream is $6,453 when discounted at 10 percent annually. What is the value of the missing cash flow?

Year	Cash Flow
1	$1,200
2	?
3	2,400
4	2,600

40. **Calculating Present Values** You just won the TVM Lottery. You will receive $1 million today plus another 10 annual payments that increase by $350,000 per year. Thus, in one year you receive $1.35 million. In two years, you get $1.7 million, and so on. If the appropriate interest rate is 9 percent, what is the present value of your winnings?

41. **EAR versus APR** You have just purchased a new warehouse. To finance the purchase, you've arranged for a 30-year mortgage for 80 percent of the $2,600,000 purchase price. The monthly payment on this loan will be $14,000. What is the APR on this loan? The EAR?

42. **Present Value and Break-Even Interest** Consider a firm with a contract to sell an asset for $135,000 three years from now. The asset costs $96,000 to produce today. Given a relevant discount rate on this asset of 13 percent per year, will the firm make a profit on this asset? At what rate does the firm just break even?

43. **Present Value and Multiple Cash Flows** What is the present value of $4,000 per year, at a discount rate of 7 percent, if the first payment is received 9 years from now and the last payment is received 25 years from now?

44. **Variable Interest Rates** A 15-year annuity pays $1,500 per month, and payments are made at the end of each month. If the interest rate is 13 percent compounded monthly for the first seven years, and 9 percent compounded monthly thereafter, what is the present value of the annuity?

45. **Comparing Cash Flow Streams** You have your choice of two investment accounts. Investment A is a 15-year annuity that features end-of-month $1,200 payments and has an interest rate of 9.8 percent compounded monthly. Investment B is a 9 percent continuously compounded lump-sum investment, also good for 15 years. How much money would you need to invest in B today for it to be worth as much as Investment A 15 years from now?

46. **Calculating Present Value of a Perpetuity** Given an interest rate of 7.3 percent per year, what is the value at date $t = 7$ of a perpetual stream of $2,100 annual payments that begins at date $t = 15$?

47. **Calculating EAR** A local finance company quotes a 15 percent interest rate on one-year loans. So, if you borrow $26,000, the interest for the year will be $3,900. Because you must repay a total of $29,900 in one year, the finance company requires you to pay $29,900/12, or $2,491.67, per month over the next 12 months. Is this a 15 percent loan? What rate would legally have to be quoted? What is the effective annual rate?

48. **Calculating Present Values** A 5-year annuity of ten $4,500 semiannual payments will begin 9 years from now, with the first payment coming 9.5 years from now. If the discount rate is 12 percent compounded monthly, what is the value of this annuity five years from now? What is the value three years from now? What is the current value of the annuity?

49. **Calculating Annuities Due** Suppose you are going to receive $10,000 per year for five years. The appropriate interest rate is 11 percent.

    1. What is the present value of the payments if they are in the form of an ordinary annuity? What is the present value if the payments are an annuity due?

    2. Suppose you plan to invest the payments for five years. What is the future value if the payments are an ordinary annuity? What if the payments are an annuity due?

    3. Which has the highest present value, the ordinary annuity or annuity due? Which has the

highest future value? Will this always be true?

50. **Calculating Annuities Due** You want to buy a new sports car from Muscle Motors for $65,000. The contract is in the form of a 48-month annuity due at a 6.45 percent APR. What will your monthly payment be?

CHALLENGE (Questions 51–76)

51. **Calculating Annuities Due** You want to lease a set of golf clubs from Pings Ltd. The lease contract is in the form of 24 equal monthly payments at a 10.4 percent stated annual interest rate, compounded monthly. Because the clubs cost $3,500 retail, Pings wants the PV of the lease payments to equal $3,500. Suppose that your first payment is due immediately. What will your monthly lease payments be?

52. **Annuities** You are saving for the college education of your two children. They are two years apart in age; one will begin college 15 years from today and the other will begin 17 years from today. You estimate your children's college expenses to be $35,000 per year per child, payable at the beginning of each school year. The annual interest rate is 8.5 percent. How much money must you deposit in an account each year to fund your children's education? Your deposits begin one year from today. You will make your last deposit when your oldest child enters college. Assume four years of college.

53. **Growing Annuities** Tom Adams has received a job offer from a large investment bank as a clerk to an associate banker. His base salary will be $45,000. He will receive his first annual salary payment one year from the day he begins to work. In addition, he will get an immediate $10,000 bonus for joining the company. His salary will grow at 3.5 percent each year. Each year he will receive a bonus equal to 10 percent of his salary. Mr. Adams is expected to work for 25 years. What is the present value of the offer if the discount rate is 12 percent?

54. **Calculating Annuities** You have recently won the super jackpot in the Washington State Lottery. On reading the fine print, you discover that you have the following two options:

    1. You will receive 31 annual payments of $175,000, with the first payment being delivered today. The income will be taxed at a rate of 28 percent. Taxes will be withheld when the checks are issued.

    2. You will receive $530,000 now, and you will not have to pay taxes on this amount. In addition, beginning one year from today, you will receive $125,000 each year for 30 years. The cash flows from this annuity will be taxed at 28 percent.

    Using a discount rate of 10 percent, which option should you select?

55. **Calculating Growing Annuities** You have 30 years left until retirement and want to retire with $1.5 million. Your salary is paid annually, and you will receive $70,000 at the end of the current year. Your salary will increase at 3 percent per year, and you can earn a 10 percent return on the money you invest. If you save a constant percentage of your salary, what percentage of your salary must you save each year?

56. **Balloon Payments** On September 1, 2007, Susan Chao bought a motorcycle for $25,000. She paid $1,000 down and financed the balance with a five-year loan at a stated annual interest rate of 8.4 percent, compounded monthly. She started the monthly payments exactly one month after the purchase (i.e., October 1, 2007). Two years later, at the end of October 2009, Susan got a new job and decided to pay off the loan. If the bank charges her a 1 percent prepayment penalty based on the loan balance, how much must she pay the bank on November 1, 2009?

57. **Calculating Annuity Values** Bilbo Baggins wants to save money to meet three objectives. First, he would like to be able to retire 30 years from now with a retirement income of $20,000 per month for 20 years, with the first payment received 30 years and 1 month from now. Second, he would like to purchase a cabin in Rivendell in 10 years at an estimated cost of $320,000. Third, after he passes on at the end of the 20 years of withdrawals, he would like to leave an inheritance of $1,000,000 to his nephew Frodo. He can afford to save $1,900 per month for the next 10 years.

If he can earn an 11 percent EAR before he retires and an 8 percent EAR after he retires, how much will he have to save each month in years 11 through 30?

58. **Calculating Annuity Values** After deciding to buy a new car, you can either lease the car or purchase it with a three-year loan. The car you wish to buy costs $38,000. The dealer has a special leasing arrangement where you pay $1 today and $520 per month for the next three years. If you purchase the car, you will pay it off in monthly payments over the next three years at an 8 percent APR. You believe that you will be able to sell the car for $26,000 in three years. Should you buy or lease the car? What break-even resale price in three years would make you indifferent between buying and leasing?

59. **Calculating Annuity Values** An All-Pro defensive lineman is in contract negotiations. The team has offered the following salary structure:

Time	Salary
0	$7,500,000
1	4,200,000
2	5,100,000
3	5,900,000
4	6,800,000
5	7,400,000
6	8,100,000

All salaries are to be paid in a lump sum. The player has asked you as his agent to renegotiate the terms. He wants a $9 million signing bonus payable today and a contract value increase of $750,000. He also wants an equal salary paid every three months, with the first paycheck three months from now. If the interest rate is 5 percent compounded daily, what is the amount of his quarterly check? Assume 365 days in a year.

60. **Discount Interest Loans** This question illustrates what is known as discount interest. Imagine you are discussing a loan with a somewhat unscrupulous lender. You want to borrow $20,000 for one year. The interest rate is 14 percent. You and the lender agree that the interest on the loan will be .14 × $20,000 = $2,800. So, the lender deducts this interest amount from the loan up front and gives you $17,200. In this case, we say that the discount is $2,800. What's wrong here?

61. **Calculating Annuity Values** You are serving on a jury. A plaintiff is suing the city for injuries sustained after a freak street sweeper accident. In the trial, doctors testified that it will be five years before the plaintiff is able to return to work. The jury has already decided in favor of the plaintiff. You are the foreperson of the jury and propose that the jury give the plaintiff an award to cover the following: (1) The present value of two years' back pay. The plaintiff's annual salary for the last two years would have been $42,000 and $45,000, respectively. (2) The present value of five years' future salary. You assume the salary will be $49,000 per year. (3) $150,000 for pain and suffering. (4) $25,000 for court costs. Assume that the salary payments are equal amounts paid at the end of each month. If the interest rate you choose is a 9 percent EAR, what is the size of the settlement? If you were the plaintiff, would you like to see a higher or lower interest rate?

62. **Calculating EAR with Points** You are looking at a one-year loan of $10,000. The interest rate is quoted as 9 percent plus three points. A point on a loan is simply 1 percent (one percentage point) of the loan amount. Quotes similar to this one are very common with home mortgages. The interest rate quotation in this example requires the borrower to pay three points to the lender up front and repay the loan later with 9 percent interest. What rate would you actually be paying here? What is the EAR for a one-year loan with a quoted interest rate of 12 percent plus two points? Is your answer affected by the loan amount?

63. **EAR versus APR** Two banks in the area offer 30-year, $200,000 mortgages at 6.8 percent and charge a $2,100 loan application fee. However, the application fee charged by Insecurity Bank and Trust is refundable if the loan application is denied, whereas that charged by I. M. Greedy and Sons Mortgage Bank is not. The current disclosure law requires that any fees that will be refunded if the applicant is rejected be included in calculating the APR, but this is not required with nonrefundable

fees (presumably because refundable fees are part of the loan rather than a fee). What are the EARs on these two loans? What are the APRs?

64. **Calculating EAR with Add-On Interest** This problem illustrates a deceptive way of quoting interest rates called add-on interest. Imagine that you see an advertisement for Crazy Judy's Stereo City that reads something like this: "$1,000 Instant Credit! 16% Simple Interest! Three Years to Pay! Low, Low Monthly Payments!" You're not exactly sure what all this means and somebody has spilled ink over the APR on the loan contract, so you ask the manager for clarification.

Judy explains that if you borrow $1,000 for three years at 16 percent interest, in three years you will owe:

$$\$1{,}000 \times 1.16^3 = \$1{,}000 \times 1.56090 = \$1{,}560.90$$

Judy recognizes that coming up with $1,560.90 all at once might be a strain, so she lets you make "low, low monthly payments" of $1,560.90/36 = $43.36 per month, even though this is extra bookkeeping work for her.

Is this a 16 percent loan? Why or why not? What is the APR on this loan? What is the EAR? Why do you think this is called add-on interest?

65. **Calculating Annuity Payments** Your friend is celebrating her 35th birthday today and wants to start saving for her anticipated retirement at age 65. She wants to be able to withdraw $110,000 from her savings account on each birthday for 25 years following her retirement; the first withdrawal will be on her 66th birthday. Your friend intends to invest her money in the local credit union, which offers 9 percent interest per year. She wants to make equal annual payments on each birthday into the account established at the credit union for her retirement fund.

1. If she starts making these deposits on her 36th birthday and continues to make deposits until she is 65 (the last deposit will be on her 65th birthday), what amount must she deposit annually to be able to make the desired withdrawals at retirement?

2. Suppose your friend has just inherited a large sum of money. Rather than making equal annual payments, she has decided to make one lump-sum payment on her 35th birthday to cover her retirement needs. What amount does she have to deposit?

3. Suppose your friend's employer will contribute $1,500 to the account every year as part of the company's profit-sharing plan. In addition, your friend expects a $50,000 distribution from a family trust fund on her 55th birthday, which she will also put into the retirement account. What amount must she deposit annually now to be able to make the desired withdrawals at retirement?

66. **Calculating the Number of Periods** Your Christmas ski vacation was great, but it unfortunately ran a bit over budget. All is not lost: You just received an offer in the mail to transfer your $9,000 balance from your current credit card, which charges an annual rate of 18.6 percent, to a new credit card charging a rate of 8.2 percent. How much faster could you pay the loan off by making your planned monthly payments of $200 with the new card? What if there was a 2 percent fee charged on any balances transferred?

67. **Future Value and Multiple Cash Flows** An insurance company is offering a new policy to its customers. Typically the policy is bought by a parent or grandparent for a child at the child's birth. The details of the policy are as follows: The purchaser (say, the parent) makes the following six payments to the insurance company:

First birthday:	$ 800
Second birthday:	$ 800
Third birthday:	$ 900
Fourth birthday:	$ 900
Fifth birthday:	$1,000
Sixth birthday:	$1,000

After the child's sixth birthday, no more payments are made. When the child reaches age 65, he or she receives $350,000. If the relevant interest rate is 11 percent for the first six years and 7 percent for all subsequent years, is the policy worth buying?

68. **Annuity Present Values and Effective Rates** You have just won the lottery. You will receive $2,000,000 today, and then receive 40 payments of $750,000. These payments will start one year from now and will be paid every six months. A representative from Greenleaf Investments has offered to purchase all the payments from you for $15 million. If the appropriate interest rate is a 9 percent APR compounded daily, should you take the offer? Assume there are 12 months in a year, each with 30 days.

69. **Calculating Interest Rates** A financial planning service offers a college savings program. The plan calls for you to make six annual payments of $8,000 each, with the first payment occurring today, your child's 12th birthday. Beginning on your child's 18th birthday, the plan will provide $20,000 per year for four years. What return is this investment offering?

70. **Break-Even Investment Returns** Your financial planner offers you two different investment plans. Plan X is a $20,000 annual perpetuity. Plan Y is a 10-year, $35,000 annual annuity. Both plans will make their first payment one year from today. At what discount rate would you be indifferent between these two plans?

71. **Perpetual Cash Flows** What is the value of an investment that pays $8,500 every other year forever, if the first payment occurs one year from today and the discount rate is 13 percent compounded daily? What is the value today if the first payment occurs four years from today? Assume 365 days in a year.

72. **Ordinary Annuities and Annuities Due** As discussed in the text, an annuity due is identical to an ordinary annuity except that the periodic payments occur at the beginning of each period and not at the end of the period. Show that the relationship between the value of an ordinary annuity and the value of an otherwise equivalent annuity due is:

$$\text{Annuity due value} = \text{Ordinary annuity value} \times (1 + r)$$

Show this for both present and future values.

73. **Calculating EAR** A check-cashing store is in the business of making personal loans to walk-up customers. The store makes only one-week loans at 9 percent interest per week.

    1. What APR must the store report to its customers? What is the EAR that the customers are actually paying?

    2. Now suppose the store makes one-week loans at 9 percent discount interest per week (see Question 60). What's the APR now? The EAR?

    3. The check-cashing store also makes one-month add-on interest loans at 9 percent discount interest per week. Thus, if you borrow $100 for one month (four weeks), the interest will be ($100 × 1.09^4) – 100 = $41.16. Because this is discount interest, your net loan proceeds today will be $58.84. You must then repay the store $100 at the end of the month. To help you out, though, the store lets you pay off this $100 in installments of $25 per week. What is the APR of this loan? What is the EAR?

74. **Present Value of a Growing Perpetuity** What is the equation for the present value of a growing perpetuity with a payment of C one period from today if the payments grow by C each period?

75. **Rule of 72** A useful rule of thumb for the time it takes an investment to double with discrete compounding is the "Rule of 72." To use the Rule of 72, you simply divide 72 by the interest rate to determine the number of periods it takes for a value today to double. For example, if the interest rate is 6 percent, the Rule of 72 says it will take 72/6 = 12 years to double. This is approximately equal to the actual answer of 11.90 years. The Rule of 72 can also be applied to determine what