

ADDITIONAL TIME VALUE OF MONEY QUESTIONS AND PROBLEMS

Concept Questions

1. **Compounding and Period** As you increase the length of time involved, what happens to future values? What happens to present values?
2. **Interest Rates** What happens to the future value of an annuity if you increase the rate r ? What happens to the present value?
3. **Present Value** Suppose two athletes sign 10-year contracts for €80 million. In one case, we're told that the €80 million will be paid in 10 equal installments. In the other case, we're told that the €80 million will be paid in 10 installments, but the installments will increase by 5 percent per year. Who got the better deal?
4. **APR and EAR** Should lending laws be changed to require lenders to report EARs instead of APRs? Why or why not?
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 for the next five questions:

On December 2, 1982, General Motors Acceptance Corporation (GMAC), a subsidiary of General Motors, offered some securities for sale to the public. Under the terms of the deal, GMAC promised to repay the owner of one of these securities \$10,000 on December 1, 2012, but the investors would receive nothing until then. Investors paid GMAC \$500 for each of these securities on December 2, 1982, for the promise of a \$10,000 payment 30 years later.

6. **Time Value of Money** Why would GMAC be willing to accept such a small amount today (\$500) in exchange for a promise to repay 20 times that amount (\$10,000) in the future?
7. **Call Provisions** GMAC has the right to buy back the securities anytime it wishes by paying \$10,000 (this 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 £500 today in exchange for £10,000 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 GMAC offered the security for \$500, 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 GMAC 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 \$500 original price? Why? If you looked in the year 2010, do you think the price would be higher or lower than today's price? Why?

Questions and Problems

BASIC

[Questions 1–20]

1. **Simple Interest versus Compound Interest** First City Bank pays 7 percent simple interest on its savings account balances, whereas Second City Bank pays 7 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 5 years?
2. **Calculating Future Values** Compute the future value of €1,000 compounded annually for
 - a. 10 years at 6 percent.
 - b. 10 years at 7 percent.
 - c. 20 years at 6 percent.
 - d. 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	5%	£ 15,451
	9	11	51,557
	18	16	886,073
	23	19	550,164

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

Present Value	Years	Interest Rate	Future Value
\$ 265	2		\$ 307
360	9		896
39,000	15		162,181
46,523	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
¥ 625,000		9%	¥ 1,284,000
810,000		7	4,341,000
18,400,000		21	402,662,000
21,500,000		29	173,439,000

6. **Calculating the Number of Periods** At 6 percent interest, how long does it take to double your money? To quadruple it?
7. **Calculating Present Values** Will Do Later, Inc., has an unfunded pension liability of \$800 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 9.5 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 Quatorze 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 15 percent.
10. **Continuous Compounding** Compute the future value of \$1,000 continuously compounded for
- 5 years at a stated annual interest rate of 12 percent.
 - 3 years at a stated annual interest rate of 10 percent.
 - 10 years at a stated annual interest rate of 5 percent.
 - 8 years at a stated annual interest rate of 7 percent.
11. **Present Value and Multiple Cash Flows** Bawati Restoration 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	EGP 1,200
2	600
3	855
4	1,480

12. **Present Value and Multiple Cash Flows** Investment X offers to pay you CNY 4,000 per year for nine years, whereas Investment Y offers to pay you CNY 6,000 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 PKR 3,600 per year for 15 years, with the first payment occurring one year from now. If the required return is 10 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 \$15,000 per year forever. If the required return on this investment is 8 percent, how much will you pay for the policy? Suppose the Perpetual Life Insurance Co. told you the policy costs \$195,000. 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)
11%	Quarterly	
7	Monthly	
9	Daily	
17	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	8.1%
	Monthly	7.6
	Weekly	16.8
	Infinite	26.2

17. **Calculating EAR** First National Bank charges 12.2 percent compounded monthly on its business loans. First United Bank charges 12.5 percent compounded semiannually. As a potential borrower, to which bank would you go for a new loan?

INTERMEDIATE
(Questions 21–50)

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 KRW 500 per month. You will charge .9 percent per month interest on the overdue balance. If the current balance is KRW 16,500, 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?
21. **Future Value** What is the future value in three years of \$1,000 invested in an account with a stated annual interest rate of 8 percent,
a. Compounded annually?
b. Compounded semiannually?
c. Compounded monthly?
d. Compounded continuously?
e. Why does the future value increase as the compounding period shortens?
22. **Simple Interest versus Compound Interest** First Simple Bank pays 8 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 LKR 700 a month in a stock account and LKR 300 a month in a bond account. The return of the stock account is expected to be 11 percent, and the bond account will pay 7 percent. When you retire, you will combine your money into an account with a 9 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-front costs of £50,000. Investment G returns £85,000 in five years. Investment H returns £175,000 in 10 years. Which of these investments has the higher return?
26. **Growing Perpetuities** I. M. Smart 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 INR 200,000, received two years from today. Subsequent annual cash flows will grow at 5 percent in perpetuity. What is the present value of the technology if the discount rate is 10 percent?
27. **Perpetuities** Zumo Financial designed a new security that pays a quarterly dividend of ¥1,000 in perpetuity. The first dividend occurs one quarter from today. What is the price of the security if the stated annual interest rate is 12 percent, compounded quarterly?
28. **Annuity Present Values** What is the present value of an annuity of NZD 2,000 per year, with the first cash flow received three years from today and the last one received 22 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 \$500 a year? The annuity's first payment occurs at the end of year 6. The annual interest rate is 12 percent for years 1 through 5, and 15 percent thereafter.
30. **Balloon Payments** Qi Fung has just arranged to purchase a CNY 40,000,000 vacation home in the Macao with a 20 percent down payment. The mortgage has an 8 percent stated

annual interest rate, compounded monthly, and calls for equal monthly payments over the next 30 years. His 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 Qi'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 1.90 percent per year, compounded monthly for the first six months, increasing thereafter to 16 percent compounded monthly. Assuming you transfer the £4,000 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** Upala Pharmaceuticals is considering a drug project that costs CRC 240,000 today and is expected to generate end-of-year annual cash flows of CRC 21,000, forever. At what discount rate would Upala 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 \$50,000. Cash flows from increased sales will be \$12,000 the first year. These cash flows will increase by 6 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 SAR 400,000, 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 2 percent of your annual salary in an account that will earn 8 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 10-year annuity of VND 5,000 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 €100, 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 €15,000?
37. **Calculating Annuity Present Values** You want to borrow \$45,000 from your local bank to buy a new sailboat. You can afford to make monthly payments of \$950, 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 \$200,000. 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 \$1,000, 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 \$1,000?
39. **Present and Future Values** The present value of the following cash flow stream is PHP 5,979 when discounted at 10 percent annually. What is the value of the missing cash flow?

Year	Cash Flow
1	PHP 1,000
2	?
3	2,000
4	2,000

40. **Calculating Present Values** You just won the TVM Lottery. You will receive ¥1 million today plus another 10 annual payments that increase by ¥400,000 per year. Thus, in one year you receive ¥1.4 million. In two years, you get ¥1.8 million, and so on. If the appropriate interest rate is 12 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 £1,600,000 purchase price. The monthly payment on this loan will be £10,000. 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 \$115,000 three years from now. The asset costs \$72,000 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 \$2,000 per year, at a discount rate of 10 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 ILS 1,500 per month, and payments are made at the end of each month. If the interest rate is 15 percent compounded monthly for the first seven years, and 12 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 €1,000 payments and has an interest rate of 10.5 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 6.5 percent per year, what is the value at date $t = 7$ of a perpetual stream of \$3,000 payments that begins at date $t = 15$?
47. **Calculating EAR** A local finance company quotes a 14 percent interest rate on one-year loans. So, if you borrow £20,000, the interest for the year will be £2,800. Because you must repay a total of £22,800 in one year, the finance company requires you to pay £22,800/12, or £1,900, per month over the next 12 months. Is this a 14 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 semiannual payments of CAD 10,000 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** As discussed in the text, an ordinary annuity assumes equal payments at the end of each period over the life of the annuity. An *annuity due* is the same thing except the payments occur at the beginning of each period instead. Thus, a three-year annual annuity due would have periodic payment cash flows occurring at Years 0, 1, and 2, whereas a three-year annual ordinary annuity would have periodic payment cash flows occurring at Years 1, 2, and 3.
 - a. At a 9.5 percent annual discount rate, find the present value of a six-year ordinary annuity contract of CNY 525 payments.
 - b. Find the present value of the same contract if it is an annuity due.
50. **Calculating Annuities Due** You want to buy a new sports car from Muscle Motors for AUD 56,000. The contract is in the form of a 48-month annuity due at an 8.15 percent APR. What will your monthly payment be?
51. **Calculating Annuities Due** You want to lease a set of golf clubs from Hook N Shank. The lease contract is in the form of 24 equal monthly payments at a 12 percent stated annual interest rate, compounded monthly. Because the clubs cost \$4,000 retail, Hook N Shank wants the PV of the lease payments to equal \$4,000. 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 \$23,000 per year per child, payable at the beginning of each school year. The annual interest rate is 5.5 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** Mitchai Khieu has received a job offer from a large investment bank as a clerk to an associate banker. His base salary will be VND 75,000. He will receive his first annual salary payment one year from the day he begins to work. In addition, he will get an immediate VND 10,000 bonus for joining the company. His salary will grow at 4 percent each year. Each year he will receive a bonus equal to 10 percent of his salary. Mr. Mitchai 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:
- You will receive 31 annual payments of \$160,000, 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.
 - You will receive \$446,000 now, and you will not have to pay taxes on this amount. In addition, beginning one year from today, you will receive \$101,055 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 INR 1 million. Your salary is paid annually, and you will receive INR 55,000 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, 2004, Tsing Chao bought a motorcycle for CNY 15,000. She paid CNY 1,000 down and financed the balance with a five-year loan at a stated annual interest rate of 9.6 percent, compounded monthly. She started the monthly payments exactly one month after the purchase (i.e., October 1, 2004). Two years later, at the end of October 2006, Tsing 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, 2006?
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 €25,000 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 €350,000. Third, after he passes on at the end of the 20 years of withdrawals, he would like to leave an inheritance of €750,000 to his nephew Frodo. He can afford to save €2,100 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 £35,000. The dealer has a special leasing arrangement where you pay £1 today and £450 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 £23,000 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	\$8,000,000
1	\$4,000,000
2	\$4,800,000
3	\$5,700,000
4	\$6,400,000
5	\$7,000,000
6	\$7,500,000

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 4.5 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 12 percent. You and the lender agree that the interest on the loan will be $.12 \times £20,000 = £2,400$. So, the lender deducts this interest amount from the loan up front and gives you £17,600. In this case, we say that the discount is £2,400. 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 \$40,000 and \$43,000, respectively. (2) The present value of five years' future salary. You assume the salary will be \$45,000 per year. (3) \$100,000 for pain and suffering. (4) \$20,000 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 PHP 10,000. The interest rate is quoted as 10 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 10 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 13 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 7.5 percent and charge a €1,500 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 Qun's Stereo City that reads something like this: "CNY 1,000 Instant Credit! 15% 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.

Qun explains that if you borrow CNY 1,000 for three years at 15 percent interest, in three years you will owe:

$$\text{CNY } 1,000 \times 1.15^3 = \text{CNY } 1,000 \times 1.52088 = \text{CNY } 1,520.88$$

Qun recognizes that coming up with CNY 1,520.88 all at once might be a strain, so he lets you make “low, low monthly payments” of $\text{CNY } 1,520.88/36 = \text{CNY } 42.25$ per month, even though this is extra bookkeeping work for him.

Is this a 15 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** This is a classic retirement problem. A time line will help in solving it. 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 £90,000 from her savings account on each birthday for 15 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 8 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.
- 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?
 - 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?
 - 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 £25,000 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 €10,000 balance from your current credit card, which charges an annual rate of 19.2 percent, to a new credit card charging a rate of 9.2 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: | \$750 |
| Second birthday: | \$750 |
| Third birthday: | \$850 |
| Fourth birthday: | \$850 |
| Fifth birthday: | \$950 |
| Sixth birthday: | \$950 |
- After the child’s sixth birthday, no more payments are made. When the child reaches age 65, he or she receives \$250,000. 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 £1,000,000 today, and then receive 40 payments of £500,000. These payments will start one year from now and will be paid every six months. A representative from Get Rich Now has offered to purchase all the payments from you for £10 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 CAD 10,000 annual perpetuity. Plan Y is a 10-year, CAD 22,000 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 AUD 6,700 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?
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 10 percent interest per week.
- What APR must the store report to its customers? What is the EAR that the customers are actually paying?
 - Now suppose the store makes one-week loans at 10 percent discount interest per week (see Question 60). What's the APR now? The EAR?
 - 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 $(€100 \times 1.09^4) - 100 = €41.16$. 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 interest rate is needed to double money in a specified period. This is a useful approximation for many interest rates and periods. At what rate is the Rule of 72 exact?
76. **Rule of 69.3** A corollary to the Rule of 72 is the Rule of 69.3. The Rule of 69.3 is exactly correct except for rounding when interest rates are compounded continuously. Prove the Rule of 69.3 for continuously compounded interest.

S&P Problems



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- Under the "Excel Analytics" link find the "Mthly. Adj. Price" for Elizabeth Arden (RDEN) stock. What was your annual return over the last four years assuming you purchased the stock at the close price four years ago? (Assume no dividends were paid.) Using this same return, what price will Elizabeth Arden stock sell for five years from now? Ten years from now? What if the stock price increases at 11 percent per year?
- Calculating the Number of Periods** Find the monthly adjusted stock prices for Southwest Airlines (LUV). You find an analyst who projects the stock price will increase 12 percent per year for the foreseeable future. Based on the most recent monthly stock price, if the projection holds true, when will the stock price reach \$150? When will it reach \$200?