Review Questions

1. What is the difference between simple interest and compound interest? Why do you end up with more money with compound interest?

2. Explain how New College could claim that a debt of $224 from 335 years ago is worth $291 billion today. How does this show the "power of compounding"?

3. State the general form of the compound interest formula, and define A, P, r, and n. Give an example that uses this formula.

4. State the compound interest formula for interest paid once a year. Define APR and briefly explain how this formula is related to the general compound interest formula.

5. State the compound interest formula for interest paid more than once a year. Define n, and explain how this formula is related to the general compound interest formula.

6. What is an annual percentage yield (APY)? Explain why, for a given APR, the APY is higher if the interest is compounded more frequently.

7. What is continuous compounding? How does the APY for continuous compounding compare to the APY for daily compounding? Explain the use of the formula for continuous compounding.

8. Give an example of a situation in which you might want to solve the compound interest formula to find the principal P that must be invested now to yield a particular amount A in the future.

Does It Make Sense?

Decide whether each of the following statements makes sense (or is clearly true) or does not make sense (or is clearly false). Explain your reasoning.

9. Simple Bank was offering simple interest at 5% per year, which was clearly a better deal than the 4.5% compound interest rate at Complex Bank.

10. Both banks were paying the same annual percentage rate (APR), but one had a higher annual percentage yield than the other (APY).

11. The bank that pays the highest annual percentage rate (APR) is always the best deal.

12. No bank could afford to pay interest every trillionth of a second because, with compounding, they would owe everyone infinite dollars.

13. My bank paid an annual interest rate (APR) of 5.0%, but at the end of the year my account balance had grown by 5.1%.

14. If you deposit $10,000 in an investment account today, it can double in value to $20,000 in just a couple decades even at a relatively low interest rate (say 5-7%).

Basic Skills & Concepts


15. \[ 2x - 4 = 6 \]
16. \[ 16 - 8 = 2 \]
17. \[ x + 7 = 4 \]
18. \[ x + 7 = 4 \]
19. \[ 2x = 12 \]
20. \[ 4y = 28 \]
21. \[ 3x = 15 \]
22. \[ 2a = 150 \]
23. \[ 2a = 5 = 12 \]
24. \[ 5a = 5 = 15 \]
25. \[ 3a + 4 = 13 \]
26. \[ 3a + 4 = 13 \]
27. \[ 4a + 8 = 24 \]
28. \[ 5a + 4 = 24 \]
29. \[ 5 - 2a = 9 \]
30. \[ 6 - 2y = 9 - y \]

Simple Interest. In Exercises 31-34, calculate the amount of money you'll have at the end of the indicated period of time.

31. You invest $800 in an account that pays simple interest of 5% for 5 years.

32. You invest $1000 in an account that pays simple interest of 7% for 5 years.

33. You invest $2000 in an account that pays simple interest of 3% for 20 years.

34. You invest $5000 in an account that pays simple interest of 6.5% for 20 years.

Simple vs. Compound Interest. Exercises 35-36 describe the similar, but not identical, investment accounts. Make a table that shows the performance of both accounts for 5 years. The table should list the account balance at the end of each year and balance after 5 years. How does the performance of both accounts differ?

35. A bank offers an APR of 2.5% compounded daily.
36. A bank offers an APR of 4.5% compounded quarterly.

Continuous Compounding. In Exercises 37-42, use the compound interest formula to determine the accumulated balance after the stated period. Assume that interest is compounded continuously.

37. $2000 is invested at an APR of 3% for 10 years.
38. $10,000 is invested at an APR of 5% for 20 years.
39. $30,000 is invested at an APR of 7% for 25 years.
40. $50,000 is invested at an APR of 1% for 12 years.
41. $100,000 is invested at an APR of 5% for 25 years.
42. $100,000 is invested at an APR of 8.5% for 30 years.

Compounding More Than Once a Year. In Exercises 43-50, use the compound interest formula for compounding more than once a year to determine the accumulated balance after the stated period.

43. A $1000 deposit at an APR of 3.5% with monthly compounding for 10 years.
44. A $2000 deposit at an APR of 3% with daily compounding for 4 years.
45. A $3000 deposit at an APR of 5.0% with quarterly compounding for 20 years.
46. A $10,000 deposit at an APR of 2.75% with monthly compounding for 5 years.

Annual Percentage Yield (APY). Find the annual percentage yield (APY) for the bonds described in Exercises 51-54.

51. A bond offers an APR of 2.5% compounded daily.
52. A bond offers an APR of 4.5% compounded monthly.
53. A bond offers an APR of 3.25% compounded quarterly.
54. A bond offers an APR of 2.25% compounded quarterly.

Planning Ahead with Compounding. For Exercises 55-64, suppose you plan to save today for a $10,000 down payment that you plan to make on a house in 10 years. Assume that you make no deposits into the account after your initial deposit. For each account described, how much would you have to deposit now in order to reach your $10,000 goal in 10 years?

55. An account with annual compounding and an APR of 5%.
56. An account with quarterly compounding and an APR of 5%.
57. An account with monthly compounding and an APR of 6%.
58. An account with daily compounding and an APR of 6%.
59. A $100,000 college fund. You want to have a $100,000 college fund in 18 years. How much will you have to deposit now under each of the scenarios in Exercises 65-68?
60. An APR of 4%, compounded daily.
61. An APR of 5.5%, compounded daily.
67. An APR of 5%, compounded monthly
68. An APR of 3.5%, compounded monthly

Further Applications

Small Rate Differences. Exercises 69–70 describe two similar, but not identical, investment accounts, in each case, compare the balances after 10 years and after 30 years. Briefly discuss the effects of the small difference in interest rates.

69. Chang invests $500 in a savings account that earns 3.5% compounded annually. Kim invests $600 in a different savings account that earns 3.75% compounded annually.
70. Jose invests $1500 in a savings account that earns 5.0% compounded annually. Maria invests $1500 in a different savings account that earns 5.75% compounded annually.

71. Comparing Annual Yields. Consider an account with an APR of 6.4%. Find the APY with quarterly compounding, monthly compounding, and daily compounding. Comment on how changing the compounding period affects the annual yield.

72. Comparing Annual Yields. Consider an account with an APR of 7.8%. Find the APY with quarterly compounding, monthly compounding, and daily compounding. Comment on how changing the compounding period affects the annual yield.

73. Rates of Compounding. Compare the accumulated balance in two accounts that both start with an initial deposit of $1000. Both accounts have an APR of 5.5%, but one account compounds interest daily while the other account compounds interest weekly. Make a table that shows the interest earned each year and the accumulated balance to both accounts for the first 10 years. Compare the balance in the accounts, in percentage terms, after 10 years. Round all figures to the nearest dollar.

74. Understanding Annual Percentage Yield (APY). a. Explain why APR and APY are the same with annual compounding.
b. Explain why APR and APY are different with daily compounding.
c. Does APY depend on the starting principal? Why or why not?
d. How does APY depend on the number of compounded periods during a year? Explain.

75. Comparing Investment Plans. Bernadette deposits $1000 in a savings account that compounds interest annually at an APR of 8%. Carla deposits $1000 in a savings account that compounds interest daily at an APR of 5%. Who will have the higher accumulated balance after 5 years and after 20 years? Explain.

76. Comparing Investment Plans. Brian invests $1600 in an account with annual compounding and an APR of 5.5%. Celebrity invests $1400 in an account with continuous compounding and an APR of 5.2%. Determine who has the higher accumulated balance after 5 years and after 20 years. Discuss the effect of the APR and the compounding period.

77. Retirement Fund. You want to accumulate $75,000 for your retirement in 30 years. You have two choices. Plan A is an account with annual compounding and an APR of 5%. Plan B is an account with continuous compounding and an APR of 4.5%. How much of an investment does each plan require to reach your goal?

78. Your Bank Account. Find the current APR, the compounding period, and the claimed APY for your personal savings account. (Choose just one account if you have more than one, or pick one from a nearby bank if you don't have an account.) a. Calculate the APY on your account. Does your calculation agree with the APY claimed by the bank? Explain.
b. Suppose you receive a gift of $10,000 and place it in your account. If the interest rate never changes, how much will you have in 10 years?
c. Suppose you find another account that offers interest at an APR that is 2 percentage points higher than yours, with the same compounding period. For the $10,000 deposit, how much would you have in 10 years? Briefly discuss how this result compares to the result from part b.

Finding Time Periods. Use a calculator and possibly some trial and error to answer Exercises 79–81.

79. How long will it take your money to triple at an APR of 8% compounded annually?
80. How long will it take your money to grow by 50% at an APR of 7% compounded annually?
81. You deposit $1000 in an account that pays an APR of 7% compounded annually. How long will it take for your balance to reach $1900.00?

Continuous Compounding. Explore continuous compounding by answering the following questions:

a. For an APR of 12%, make a table similar to Table 4.4, in which you display the APY for n = 1, 4, 12, 365, 500, 1000.
b. Find the APY for continuous compounding at an APR of 12%.
c. Show the results of parts a and b on a graph similar to Figure 4.3.
d. In words, compare the APY with continuous compounding to the APY with other types of compounding.
e. You deposit $500 in an account with an APR of 12%. With continuous compounding, how much money will you have at the end of 1 year? at the end of 5 years?

Web Projects
Find useful links for Web Projects on the text Web site: www.awc.com/bennett-briggs

Compounding Interest Calculators. Although you know how to calculate balances with the compound interest formula, the Web has many compound interest calculators. Find such a calculator on the Web. Experiment with various APRs, Initial deposits, and compounding periods to determine if the Web calculator is accurate. Note and discuss any terms that are new or different from those you encountered in this unit.

84. Money Stretchers. The Money Stretchers is a Web-based tutorial on compound interest. Read this short article and comment on its accuracy, given what you have learned in this unit.

85. Rate Comparisons. Find a Web site that compares interest rates available for ordinary savings accounts at different banks. What is the range of rates currently being offered? What is the best deal? How does your own bank account compare?

86. Bank Advertisement. Find two bank advertisements that refer to compound interest rates. Explain the terms in each advertisement. Which bank offers the better deal? Explain.

87. Power of Compounding. As an advertisement or article about an investment, find a description of how money has grown (or will grow) over a period of many years. What is the annual yield listed? How does the value of the account change?

UNIT 4B

Savings Plans and Investments

Savvy suppose you want to save money for retirement, for your child's college expenses, or for some other reason. You could deposit a lump sum of money today and let it grow through the power of compound interest. But what if you don't have a large lump sum to start such an account?

For most people, a more realistic way to save is by depositing smaller amounts on a regular basis. For example, you might put $50 a month into savings. Such long-term savings plans are so popular that many have special names—and some even get special tax treatment (see that 4D). Popular types of savings plans include Individual Retirement Accounts (IRAs), 401(k) plans, Keogh plans, and employee pension plans.

THE SAVINGS PLAN FORMULA

We can study savings plans with a simple example. Suppose you deposit $1000 into your savings plan at the end of each month. Further suppose that your plan pays interest monthly at an annual rate of APR = 12%, or 1% per month.
Does It Make Sense?

Decide whether each of the following statements makes sense (is clearly true) or does not make sense (is clearly false). Explain your reasoning.

9. If interest rates are low, my publisher will pay $200 per month to me, and I understand that my publication will be reprinted in 5 years with a 5% increase in profit per year.

10. My financial advisor showed me that I could increase my retirement goal by only $100 per month and get a total of 7% per year on average return, but I don't want to lose my job, so I'm going to do my same job by getting an average annual return of 1% instead.

11. I'm putting all my savings into stocks because stocks always outperform other types of investment over the long term.

12. I'm hoping to withdraw money from my savings account, but stocks are always at risk of losing all of the value of my investments.

13. I'm already retired, so I need low-risk investments. That's why I put most of my money in U.S. Treasury bills, notes, and bonds.

Basic Skills & Concepts


15. 316
16. 27
17. 23
18. 27
19. 32
20. 53
21. 34
22. 16
23. 64
24. 64
25. 54
26. 25

Solving with Powers and Roots. Solve the equations in Exercises 27–34 for the unknown, x.

27. x2 = 100
28. x2 = 27
29. (x/2)2 = 25

30. x3 = 3
31. x1/3 = 2
32. x1/2 = 2

33. x1/2 = 2
34. x3 = 32

Savings Plan Formula. In Exercises 35–38, calculate the balance under the given assumptions.

35. Find the savings plan balance after 9 months with an APR of 12% and monthly payments of $100.
36. Find the savings plan balance after 1 year with an APR of 12% and monthly payments of $100.
37. Find the savings plan balance after 18 months with an APR of 6% and monthly payments of $200.
38. Find the savings plan balance after 24 months with an APR of 5% and monthly payments of $250.

Investment Plans. Use the savings plan formula in Exercises 39–42.

39. Set up an IRA (individual retirement account) with an APR of 5% at age 25. At the end of each month, you deposit $50 in the account. How much will the IRA contain when you retire at age 65? Compare this amount to the initial amount of deposits made over the time period.

40. If a friend creates an IRA with an APR of 6.25%. She starts the IRA at age 25 and deposits $100 per month. How much will her IRA contain when she retires at age 65? Compare this amount to the total amount of deposits made over the time period.

41. You put $200 per month in an investment plan that pays an APR of 7%. How much money will you have after 10 years? Compare this amount to the total amount of deposits made over the time period.

42. You put $200 per month in an investment plan that pays an APR of 5%. How much money will you have after 15 years? Compare this amount to the total amount of deposits made over the time period.

Investment Planning. Use the savings plan formula in Exercises 43–46.

43. You want to create a college fund for your baby. If you can get an APR of 7.5% and want the fund to have a value of $100,000 after 18 years, how much should you deposit monthly?

44. At age 35 you start saving for retirement. If your investment plan pays an APR of 6% and you want to have $2 million when you retire in 30 years, how much should you deposit monthly?

45. You want to purchase a new car in 3 years and expect the car to cost $12,000. Your bank offers a plan with a guarantee interest rate of APR = 3.5% if you make regular monthly deposits. How much should you deposit each month to end up with $10,000 in 3 years?

46. At age 20 when you graduate, you start saving for retirement. If your investment plan pays an APR of 5% and you want to have $2 million when you retire in 45 years, how much should you deposit monthly?

Savings Plans. Use the savings plan formula in Exercises 47–50.

47. Comfortable Retirement. Suppose you are 30 years old, and you would like to retire at age 60. Furthermore, you would like to have a retirement fund from which you can draw an income of $50,000 per year. How can you do this? Assume a constant APR of 8%.

48. Very Comfortable Retirement. Suppose you are 25 years old, and you would like to retire at age 65. Furthermore, you would like to have a retirement fund from which you can draw an income of $500,000 per year. How can you do this? Assume a constant APR of 6%.

49. Total and Annual Returns. In Exercises 49–56, compute the total and annual returns on the described investment.

50. You buy 180 shares of XYZ stock for $55 per share, you sell the stock for $10,300.
51. You pay $500 for a municipal bond. When it matures after 20 years, you receive $1,500.
52. If you buy 200 shares of a mutual fund for $50, you sell them for $51,300.
53. You buy 180 shares of XYZ stock for $55 per share, you sell the stock for $10,300.
54. You buy 180 shares of each of the four stocks shown in Figure 4.5. Which one will pay you the highest dividend, in absolute dollars? How much will your dividend payment be?
Suppose your primary investment goal is to receive income from dividends. Assuming the stock prices and dividends in Figure 4.5 continue to hold, which of the four stocks would be the best investment for you? Explain.

Suppose your primary investment goal is to receive income from dividends. Which stock(s) in Figure 4.5 would make the most sense for you to invest in? Explain.

Price-to-Earnings Ratio. For each stock listed in Exercises 67-72, answer the following questions:

a. Did the company earn a profit in the past year? If so, how does its share price compare to the profit per share that it earned in the past year?

b. How much profit per share did the company earn in the past year?

c. Based on the fact that stocks historically trade at an average P/E ratio of about 12-16, does the stock price seem cheap, about right, or expensive right now? If it seems cheap or expensive, what might explain the current stock price?

Mayag, assuming Figure 4.5 comes from today's newspaper.

Mayag, based on yesterday's actual closing stock price (from a newspaper or Web site).

Motorola, assuming Figure 4.5 comes from today's newspaper.

Motorola, based on yesterday's actual closing stock price (from a newspaper or Web site).

Mueller Industries, assuming Figure 4.5 comes from today's newspaper.

Mueller Industries, based on yesterday's actual closing stock price (from a newspaper or Web site).

Bond Yields. In Exercises 73-76, calculate the current yield on the described bond.

73. A $1000 Treasury bond with a coupon rate of 2.0% that has a market value of $950

74. A $1000 Treasury bond with a coupon rate of 2.5% that has a market value of $1050

75. A $1000 Treasury bond with a coupon rate of 3.0% that has a market value of $980

76. A $1000 Treasury bond with a coupon rate of 3.9% that has a market value of $950

Bond Interest. In Exercises 77-80, calculate the annual interest you will receive on the described bond.

77. A $100 Treasury bond with a current yield of 3.9% that is quoted at 105 points

78. A $100 Treasury bond with a current yield of 1.5% that is quoted at 98 points

79. A $100 Treasury bond with a current yield of 0.2% that is quoted at 114.5 points

80. A $10,000 Treasury bond with a current yield of 3.6% that is quoted at 120.25 points

Mutual Fund Growth. Assume that Figure 4.6 comes from today's paper. Suppose you invested $500 in the Calvert Social Investment Bond Fund (SoInvBd) three years ago and reinvested all dividends and gains. What is your investment worth now?

Mutual Fund Growth. Assume that Figure 4.6 comes from today's paper. Suppose you invested $500 in the Calvert Social Investment Equity Fund (SoInvEq) three years ago and reinvested all dividends and gains. What is your investment worth now?

Further Applications

Who Comes Out Ahead? Exercises 83-86 each describe two savings plans. Compare the balances in the two plans after 10 years. Who deposits more money in each case? Who comes out ahead in each case? Comment on any other savings plans that you think are not included in the results. Assume that, for each plan, the payment and compounding periods are the same, so the savings plan formula is valid.

Yolanda deposits $100 per month in an account with an APR of 5%, while each deposits $1200 at the end of each year in an account with an APR of 5%.

Polly deposits $50 per month in an account with an APR of 6%, while Quinn deposits $40 per month in an account with an APR of 6.3%.

Juan deposits $200 per month in an account with an APR of 6%, while Maria deposits $250 at the end of each year in an account with an APR of 6.5%.

George deposits $49 per month in an account with an APR of 7%, while Harvey deposits $150 per quarter in an account with an APR of 7.3%.

Comparing Investment Plans. Suppose you want to accumulate $50,000 for your child's college fund within the next 15 years. Explain fully whether the investment plans in Exercises 87-90 will allow you to reach your goal.

87. You deposit $50 per month into an account with an APR of 6%.

88. You deposit $75 per month into an account with an APR of 6%.

89. You deposit $100 per month into an account with an APR of 6%.

90. You deposit $200 per month into an account with an APR of 6%.

91. Total Return on Stock. Suppose you bought XYZ stock 1 year ago for $50 per share and sold it at $85.25. You also pay a commission of $8.25 per share on your sale. What is the total return on your investment?

92. Total Return on Stock. Suppose you bought XYZ stock 1 year ago for $40.00 per share and sold it at $52.85. You also pay a commission of $8.25 per share on your sale. What is the total return on your investment?

Death and the Savers (A True Story). In December 1995, 91-year-old Anna Scherbina (whose passport photo is shown below) died and left $22 million to Yeshiva University. This fortune was accumulated through shrewd and patient investment of a $5000 nest egg over the course of 60 years. In turning $5000 into $22 million, what were her total and annual returns? How did her annual return compare to the average annual return for large-company stocks (see Table 4.6)?

Personal Savings Plan. Describe something for which you would like to save money right now. How much do you need to save? How long do you have to save it? Based on these needs, calculate how much you should deposit each month in a savings plan to meet your goal. For the interest rate, use the highest rate currently available at local banks.

Web Projects

Find useful links for Web projects on the text Web site: www.aw.com/bennett-briggs

Investment Tracking. Choose three stocks, three bonds, and three mutual funds that you think would make good investments. Imagine that you invest $1000 in each of these nine investments. Use the Web to track the value of your investment portfolio over the next 5 weeks. Based on the portfolio value at the end, find your return for the 5-week period. Which investments fared the best, and which did most poorly?

Dow Jones Industrial Average. The Dow Jones Company has an extensive Web site that includes its history and functionality, as well as information on the Dow Jones Industrial Average (DIA) and links to the companies that make up the DIA. Visit the Web site and choose a specific topic related to the DIA (for example, the history of the DIA, the original companies in the DIA, the best and worst days for the DIA, how the DIA is computed, using the Web site and any other resources, write a two-page paper on your topic.

Company Research. Go to the Web site of a specific company (or the 30 DJIA companies are on the Dow Jones Web site) and carry out research on that company as if you were a prospective investor. You should consider the following questions: How has the company performed over the last year? 5 years? 10 years? Does the company offer dividends? How do you interpret its P/E ratio? Overall, do you think the company is a good investment? Why or why not?

Financial Web Sites. Visit one of the many financial news and advising Web sites. Describe the services offered by the Web site. Explain whether, as an active or prospective investor, you find the Web site useful.

Other Averages. Investigate one of several other stock averages, such as Standard and Poor's or the Russell 2000. How do these averages differ from the Dow Jones...
EXAMPLE 14 Rate Approximations for ARMs
You have a choice between a 30-year fixed rate loan at 8% and an ARM with a first-year rate of 5%. Neglecting compounding and changes in principal, estimate your monthly savings with the ARM during the first year on a $100,000 loan. Suppose that the ARM rate rises to 11% by the fourth year. How will your payments be affected?

Solution. Because mortgage payments are mainly interest in the early years of a loan, we can make approximations by pretending the principal remains unchanged. For the 8% fixed rate loan, the interest on the $100,000 loan for the first year will be approximately 8% × $100,000 = $8000. With the 5% loan, your first-year interest will be approximately 5% × $100,000 = $5000. Thus, the ARM will save you about $3000 in interest during the first year, which means a monthly savings of about $250. 
By the fourth year, when rates reach 11%, the situation is reversed. The rate on the ARM is now 3 percentage points above the rate on the fixed rate loan. Instead of saving $250 per month more on the ARM than on the 8% fixed rate loan, moreover, if interest rates remain high on the ARM, you will continue to make these high payments for many years to follow. Thus, while ARMs reduce risk for the lender, they add risk for the borrower.

Now try exercises 47–49.

EXERCISES 4C

Review Questions
1. Suppose you pay only the interest on a loan. Will the loan ever be paid off? Why not?
2. What is an installment loan? Explain the meaning and use of the loan payment formula.
3. Explain, in general terms, how the portions of installment loan payments going to principal and interest change over the life of the loan.
4. Suppose you need a loan of $10,000 and are offered a choice of a 5-year loan at 7% interest or a 3-year loan at 8% interest. Discuss the pros and cons of each choice.
5. How do credit card loans differ from ordinary installment loans? Why are credit card loans particularly dangerous?
6. What is a mortgage? What is a down payment on a mortgage? Explain how closing costs, including points, can affect loan decisions.
7. The interest rate on my student loan is only 7%, yet more than half of my payments are currently going toward interest rather than principal. What can I do to reduce my interest payments?
8. My student loans were all 20-year loans at interest rates of 8% or above. So when I graduated, I was still owing over $100,000. Discuss the pros and cons of each choice.
9. I make only the minimum required payments on my credit card balance each month, because that way I'll have more of my own money to keep.
10. I carry a large credit card balance, and I have a credit card that charges an annual interest rate of 12%. So when I found another credit card that promised a 9% interest rate for the first 3 months, it was obvious that I should switch to this new card.

Does It Make Sense?

Select whether each of the following statements makes sense (is clearly true) or does not make sense (is clearly false). Explain your reasoning.

11. I had a choice between a fixed rate mortgage at 6% and an adjustable rate mortgage that started at 3% for the first year with a maximum increase of 1.5 percentage points a year. I took the adjustable rate, because I'm planning to move within three years.
12. I had rate loans with 15-year terms have lower interest rates than loans with 20-year terms, so it always makes sense to take the 15-year loan.

Basic Skills & Concepts

Loan Terminology. For the loans described in Exercises 13–14, do the following:
1. Identify the starting loan principal, the annual interest rate, the number of payments per year, the loan term, and the payment amount.
2. How many payments will you make in total? What is the total amount you pay over the life of the loan?
3. Of the total amount you pay, how much will go toward principal and how much toward interest?
4. If you borrow $10,000 at an APR of 7%, which you are paying off with monthly payments of $100 for 20 years. 
5. If you borrow $5,000 at an APR of 5%, which you are paying off with monthly payments of $95 for 10 years.

Loan Payments. For the loans described in Exercises 15–24, do the following:
1. Calculate the monthly payment.
2. Determine the total payment over the term of the loan.
3. Determine how much of the total payment goes to principal and how much to interest.
4. A student loan of $25,000 at a fixed APR of 6% for 20 years.
5. A student loan of $12,000 at a fixed APR of 8% for 10 years.
6. A home mortgage of $150,000 with a fixed APR of 7.5% for 30 years.
7. A home mortgage of $150,000 with a fixed APR of 7.5% for 15 years.
8. A home mortgage of $180,000 with a fixed APR of 8.5% for 15 years.

Credit Card Debt. For Exercises 25–32, assume you have a balance of $15,000 on your credit card that you want to pay off. Calculate your monthly payment and total payment under the conditions listed. Assume you make no additional charges to the card.

9. The credit card APR is 18% and you want to pay off the balance in 1 year.
10. The credit card APR is 18% and you want to pay off the balance in 2 years.
11. The credit card APR is 21% and you want to pay off the balance in 3 years.
12. The credit card APR is 23% and you want to pay off the balance in 3 years.

4C Loan Payments, Credit Cards, and Mortgages
based on the balance for the previous month. The following table shows how you can calculate your monthly balance.

<table>
<thead>
<tr>
<th>Month</th>
<th>Payment</th>
<th>Expenses</th>
<th>Interest</th>
<th>New Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$200</td>
<td>$75</td>
<td>1.5% x $1200</td>
<td>$1200 - $200 = $1000</td>
</tr>
<tr>
<td>1</td>
<td>$200</td>
<td>$75</td>
<td>1.5% x $1200 + $75 + $18 = $1093</td>
<td></td>
</tr>
</tbody>
</table>

Complete and extend the table to show your balance at the end of each month until the debt is paid off. How long does it take to pay off the credit card debt?

34. **Credit Card Debt.** Repeat the table of Exercise 23, but this time assume that you make monthly payments of $300. Extend the table as long as necessary until your debt is paid off. How long does it take to pay off your debt?

35. **Credit Card Woes.** The following table shows the expenses and payments for 8 months on a credit card account with an initial balance of $300. Assume that the interest rate is 1.5% per month (18% APR) and that interest for a given month is charged on the balance for the previous month. Complete the table for 8 months. What is the balance on the credit card? Comment on the effect of the interest and the initial balance in light of the fact that if 7 of the 8 months expenses never exceeded payments.

<table>
<thead>
<tr>
<th>Month</th>
<th>Payment</th>
<th>Expenses</th>
<th>Interest</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$300</td>
<td>$131</td>
<td>1.5% x $300</td>
<td>$300</td>
</tr>
<tr>
<td>1</td>
<td>$150</td>
<td>$150</td>
<td>1.5% x $300 + $150 = $175.50</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$400</td>
<td>$450</td>
<td>1.5% x $300 + $450 = $450</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$500</td>
<td>$500</td>
<td>1.5% x $300 + $500 = $500</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$100</td>
<td>$100</td>
<td>1.5% x $300 + $100 = $100</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$200</td>
<td>$150</td>
<td>1.5% x $300 + $150 = $150</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$100</td>
<td>$80</td>
<td>1.5% x $300 + $80 = $80</td>
<td></td>
</tr>
</tbody>
</table>

36. **Teaser Rate.** You have a total credit card debt of $4000. You receive an offer to transfer this debt to a new card with an introductory APR of 6% for the first 6 months. After that, the rate becomes 24%.

4a. What is the monthly interest payment on $4000 during the first 6 months? (Assume you pay nothing toward principal and don’t charge any further debts.)

4b. What is the monthly interest payment on $4000 after the first 6 months? Comment on the change from the teaser rate.

**Fixed Rate Options.** Compare your monthly payments and total loan cost under the two options listed in each of Exercises 37–40. Assume that the loans are fixed rate and that closing costs are the same in both cases. Briefly discuss the pros and cons of each option.

37. You need a $100,000 loan.
   Option 1: A 30-year loan at an APR of 6%
   Option 2: A 15-year loan at 7.5%

38. You need a $75,000 loan.
   Option 1: A 30-year loan at an APR of 8%
   Option 2: A 15-year loan at 7%

39. You need a $120,000 loan.
   Option 1: A 30-year loan at an APR of 7.15%
   Option 2: A 15-year loan at 6.75%

40. You need a $100,000 loan.
   Option 1: A 30-year loan at an APR of 7.25%
   Option 2: A 15-year loan at 6.8%

41. **Closing Costs.** You need a loan of $100,000 to buy a home. Each of Exercises 41–44 offers two choices. Calculate your monthly payments and total closing costs in each case. Briefly discuss how you would decide between the two choices.

41. Choice 1: 30-year fixed rate at 8% with closing costs of $1200 and no points
   Choice 2: 30-year fixed rate at 7.5% with closing costs of $1200 and 2 points

42. Choice 1: 30-year fixed rate at 8.5% with no closing costs and no points
   Choice 2: 30-year fixed rate at 7.5% with closing costs of $1200 and 4 points

43. Choice 1: 30-year fixed rate at 7.25% with closing costs of $1200 and 1 point
   Choice 2: 30-year fixed rate at 6.75% with closing costs of $1200 and 3 points

44. Choice 1: 30-year fixed rate at 7.5% with closing costs of $1000 and no points
   Choice 2: 30-year fixed rate at 6.5% with closing costs of $1500 and 4 points

**Accelerated Loan Payment.** Suppose you have a student loan of $25,000 with an APR of 9% for 20 years.

a. What are your required monthly payments?

b. Suppose you would like to make the loan off in 10 years instead of 20. What monthly payments will you need to make?

c. Compare the total amounts you’ll pay over the loan term if you pay the loan off in 20 years versus 10 years.

46. **Accelerated Loan Payment.** Suppose you have a student loan of $60,000 with an APR of 8% for 25 years.

a. What are your required monthly payments?

b. Suppose you would like to pay the loan off in 15 years instead of 25. What monthly payments will you need to make?

c. Compare the total amounts you’ll pay over the loan term if you pay the loan off in 25 years versus 15 years.

47. **ARM Rate Approximations.** You have a choice between a 30-year fixed rate loan at 7% and an ARM with a first-year rate of 5%. Neglecting compounding and changes in principal, estimate your monthly savings with the ARM during the first year on a $150,000 loan. Suppose that the ARM rate rises to 8.5% at the start of the third year. Approximately how much extra will you then be paying over what you would have paid if you had taken the fixed rate loan?

48. **ARM Rate Approximations.** You have a choice between a 30-year fixed rate loan at 8.5% and an ARM with a first-year rate of 5.5%. Neglecting compounding and changes in principal, estimate your monthly savings with the ARM during the first year on a $125,000 loan. Suppose that the ARM rate rises to 10% at the start of the second year. Approximately how much extra will you then be paying over what you would have paid if you had taken the fixed rate loan?

**Further Applications**

49. **How Much House Can You Afford?** You can afford monthly payments of $1250. If current mortgage rates are 7.3% for a 30-year fixed rate loan, what loan principal can you afford? If you are required to make a 20% down payment and you have the cash on hand to do it, what price house can you afford? (Hint: You will need to solve the loan payment formula for P.)

50. **How Much House Can You Afford?** You can afford monthly payments of $1250. If current mortgage rates are 7.3% for a 30-year fixed rate loan, what loan principal can you afford? If you are required to make a 20% down payment and you have the cash on hand to do it, what price house can you afford? (Hint: You will need to solve the loan payment formula for P.)

51. **Student Loan Consolidation.** Suppose you have the following three student loans: $10,000 with an APR of 8% for 15 years, $15,000 with an APR of 8.5% for 20 years, and $12,500 with an APR of 9% for 10 years.

a. Calculate the monthly payment for each loan individually.

b. Calculate the total you’d pay in payments during the life of all three loans.

c. A bank offers to consolidate your three loans into a single loan with an APR of 8.5% and a loan term of 20 years. What will your monthly payments be in that case? What will your total payments be over the 20 years? Discuss the pros and cons of accepting this loan consolidation.

52. **Bad Deal: Car Title Lenders.** Some "car-title lenders" offer quick cash loans in exchange for being allowed to hold the title to your car as collateral (you lose your car if you fail to pay off the loan). In many states, these lenders operate under pawnbroker laws that allow them to charge fees as a percentage of the unpaid balance. Suppose you need $2000 (in cash), and a car-title company offers you a loan at an interest rate of 2% per month plus a monthly fee of 20% of the unpaid balance.