

### **EXAMPLE 9.1: FRM EXAM 2003—QUESTION 95**

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With any other factors remaining unchanged, which of the following statements regarding bonds is *not* valid?

- a. The price of a callable bond increases when interest rates increase.
- b. Issuance of a callable bond is equivalent to a short position in a straight bond plus a long call option on the bond price.
- c. The put feature in a puttable bond lowers its yield compared with the yield of an equivalent straight bond.
- d. The price of an inverse floater decreases as interest rates increase.

### **EXAMPLE 9.2: CALLABLE BOND DURATION**

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A 10-year zero-coupon bond is callable annually at par (its face value) starting at the beginning of year 6. Assume a flat yield curve of 10%. What is the bond duration?

- a. 5 years
- b. 7.5 years
- c. 10 years
- d. Cannot be determined based on the data given

### **EXAMPLE 9.3: DURATION OF FLOATERS**

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A money markets desk holds a floating-rate note with an eight-year maturity. The interest rate is floating at the three-month LIBOR rate, reset quarterly. The next reset is in one week. What is the approximate duration of the floating-rate note?

- a. 8 years
- b. 4 years
- c. 3 months
- d. 1 week

**EXAMPLE 9.4: FRM EXAM 2009—QUESTION 4-16**

From the time of issuance until the bond matures, which of the following bonds is most likely to exhibit negative convexity?

- a. A puttable bond
- b. A callable bond
- c. An option-free bond selling at a discount
- d. A zero-coupon bond

**EXAMPLE 9.5: FRM EXAM 2009—QUESTION 4-12**

Your boss wants to devise a fixed-income strategy such that there is no reinvestment risk over five years. Reinvestment risk will not occur if:

- I. Interest rates remain constant over the time period the bonds are held.
  - II. The bonds purchased are callable.
  - III. The bonds purchased are issued at par.
  - IV. Only zero-coupon bonds with a five-year maturity are purchased.
- a. I only
  - b. I and II only
  - c. III only
  - d. I and IV

**EXAMPLE 9.6: FRM EXAM 2009—QUESTION 4-11**

Consider a bond with par value of EUR 1,000 and maturity in three years, and that pays a coupon of 5% annually. The spot rate curve is as follows: 1-year, 6%; 2-year, 7%; and 3-year, 8%. The value of the bond is closest to:

- a. 904
- b. 924
- c. 930
- d. 950

**EXAMPLE 9.7: FRM EXAM 2007—QUESTION 32**

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The price of a three-year zero-coupon government bond is \$85.16. The price of a similar four-year bond is \$79.81. What is the one-year implied forward rate from year 3 to year 4?

- a. 5.4%
- b. 5.5%
- c. 5.8%
- d. 6.7%

**EXAMPLE 9.8: FRM EXAM 2009—QUESTION 3-24**

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The term structure of swap rates is: 1-year, 2.50%; 2-year, 3.00%; 3-year, 3.50%; 4-year, 4.00%; 5-year, 4.50%. The two-year forward swap rate starting in three years is closest to

- a. 3.50%
- b. 4.50%
- c. 5.51%
- d. 6.02%

### **EXAMPLE 9.9: SHAPE OF TERM STRUCTURE**

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Suppose that the yield curve is upward sloping. Which of the following statements is *true*?

- a. The forward rate yield curve is above the zero-coupon yield curve, which is above the coupon-bearing bond yield curve.
- b. The forward rate yield curve is above the coupon-bearing bond yield curve, which is above the zero-coupon yield curve.
- c. The coupon-bearing bond yield curve is above the zero-coupon yield curve, which is above the forward rate yield curve.
- d. The coupon-bearing bond yield curve is above the forward rate yield curve, which is above the zero-coupon yield curve.

### **EXAMPLE 9.10: FRM EXAM 2004—QUESTION 61**

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According to the pure expectations hypothesis, which of the following statements is *correct* concerning the expectations of market participants in an upward-sloping yield curve environment?

- a. Interest rates will increase and the yield curve will flatten.
- b. Interest rates will increase and the yield curve will steepen.
- c. Interest rates will decrease and the yield curve will flatten.
- d. Interest rates will decrease and the yield curve will steepen.

**EXAMPLE 9.11: FRM EXAM 2007—QUESTION 50**

A portfolio consists of two zero-coupon bonds, each with a current value of \$10. The first bond has a modified duration of one year and the second has a modified duration of nine years. The yield curve is flat, and all yields are 5%. Assume all moves of the yield curve are parallel shifts. Given that the daily volatility of the yield is 1%, which of the following is the best estimate of the portfolio's daily value at risk (VAR) at the 95% confidence level?

- a. USD 1.65
- b. USD 2.33
- c. USD 1.16
- d. USD 0.82

**EXAMPLE 9.12: FRM EXAM 2002—QUESTION 128**

During 2002, an Argentinean pension fund with 80% of its assets in dollar-denominated debt lost more than 40% of its value. Which of the following reasons could explain all of the 40% loss?

- a. The assets were invested in a diversified portfolio of AAA firms in the United States.
- b. The assets invested in local currency in Argentina lost all of their value, while the value of the dollar-denominated assets stayed constant.
- c. The dollar-denominated assets were invested in U.S. Treasury debt, but the fund had bought credit protection on sovereign debt from Argentina.
- d. The fund had invested 80% of its funds in dollar-denominated sovereign debt from Argentina.

**EXAMPLE 9.13: FRM EXAM 2008—QUESTION 2-41**

Which of the following would *not* cause an upward-sloping yield curve?

- a. An investor preference for short-term instruments
- b. An expected decline in interest rates
- c. An improving credit risk outlook
- d. An expected increase in the inflation rate

## 9.5 ANSWERS TO CHAPTER EXAMPLES

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### Example 9.1: FRM Exam 2003—Question 95

a. Answer b. is valid because a short position in a callable bond is the same as a short position in a straight bond plus a long position in a call (the issuer can call the bond back). Answer c. is valid because a put is favorable for the investor, so it lowers the yield. Answer d. is valid because an inverse floater has high duration.

### Example 9.2: Callable Bond Duration

c. Because this is a zero-coupon bond, it will always trade below par, and the call should never be exercised. Hence its duration is the maturity, 10 years.

### Example 9.3: Duration of Floaters

d. Duration is not related to maturity when coupons are not fixed over the life of the investment. We know that at the next reset, the coupon on the FRN will be set at the prevailing rate. Hence, the market value of the note will be equal to par at that time. The duration or price risk is only related to the time to the next reset, which is one week here.

### Example 9.4: FRM Exam 2009—Question 4-16

b. A callable bond is short an option, which creates negative convexity for some levels of interest rates. Regular bonds, as in answers c. and d., have positive convexity, as well as puttable bonds.

### Example 9.5: FRM Exam 2009—Question 4-12

d. Reinvestment risk occurs when the intermediate coupon payments have to be reinvested at a rate that differs from the initial rate. This does not happen if interest rates stay constant, or with zero-coupon bonds. Callable bonds can be called early, which creates even more reinvestment risk for the principal.

### Example 9.6: FRM Exam 2009—Question 4-11

b. The price is  $50/(1 + 6\%) + 50/(1 + 7\%)^2 + 1,050/(1 + 8\%)^3 = 924.36$ .

### Example 9.7: FRM Exam 2007—Question 32

d. The forward rate can be inferred from  $P_4 = P_3/(1 + F_{3,4})$ , or  $(1 + R_4)^4 = (1 + R_3)^3(1 + F_{3,4})$ . Solving, this gives  $F_{3,4} = (85.16/79.81) - 1 = 0.067$ .

### Example 9.8: FRM Exam 2009—Question 3-24

d. We compute first the accrual of a dollar over three and five years. For  $T = 3$ , this is  $(1 + 3.50\%)^3 = 1.10872$ . For  $T = 5$ , this is  $(1 + 4.50\%)^5 = 1.24618$ . This

gives  $1.24618 = (1 + F_{3,5})^2 \times 1.10872$ . Solving, we find 6.018%. Note that we can use Equation (9.13) for an approximation. Here, this is  $5R_5 = 3R_3 + 2F_{3,5}$ , or  $F_{3,5} = R_5 + (3/2)(R_5 - R_3) = 4.50\% + 1.5(4.50\% - 3.50\%) = 6\%$ .

### **Example 9.9: Shape of Term Structure**

a. See Figures 9.3 and 9.4. The coupon yield curve is an average of the spot, zero-coupon curve; hence it has to lie below the spot curve when it is upward sloping. The forward curve can be interpreted as the spot curve plus the slope of the spot curve. If the latter is upward sloping, the forward curve has to be above the spot curve.

### **Example 9.10: FRM Exam 2004—Question 61**

a. An upward-sloping term structure implies forward rates higher than spot rates, or that short-term rates will increase. Because short-term rates increase more than long-term rates, this implies a flattening of the yield curve.

### **Example 9.11: FRM Exam 2007—Question 50**

a. The dollar duration of the portfolio is  $1 \times \$10 + 9 \times \$10 = \$100$ . Multiplied by 0.01 and 1.65, this gives \$1.65.

### **Example 9.12: FRM Exam 2002—Question 128**

d. In 2001, Argentina defaulted on its debt, both in the local currency and in dollars. Answer a. is wrong because a diversified portfolio could not have lost so much. The funds were invested at 80% in dollar-denominated assets, so b. is wrong; even a total wipeout of the local-currency portion could not explain a loss of 40% on the portfolio. If the fund had bought credit protection, it would not have lost as much, so c. is wrong. The fund must have had credit exposure to Argentina, so answer d. is correct.

### **Example 9.13: FRM Exam 2008—Question 2-41**

b. An upward-sloping yield curve could be explained by a preference for short-term maturities (answer a.), which requires a higher long-term yield, so answer a. is not the correct choice. An upward-sloping yield curve could also be explained by expectations of higher interest rates or higher inflation (d.). Finally, improving credit conditions (c.) would reduce the cumulative probability of default and thus flatten the term structure. Only an expected decline in interest rates (b.) would *not* cause an upward-sloping yield curve.