

**EXAMPLE 13.1: FRM EXAM 2000—QUESTION 79**

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Under which scenario is basis risk likely to exist?

- a. A hedge (which was initially matched to the maturity of the underlying) is lifted before expiration.
- b. The correlation of the underlying and the hedge vehicle is less than one and their volatilities are unequal.
- c. The underlying instrument and the hedge vehicle are dissimilar.
- d. All of the above are correct.

**EXAMPLE 13.2: FRM EXAM 2009—QUESTION 3-14**

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Mary has IBM stock and will sell it two months from now at a specified date in the middle of the month. Mary would like to hedge the price of risk of IBM stock. How could she best hedge the IBM stock without incurring basis risk?

- a. Short a two-month forward contract on IBM stock
- b. Short a three-month futures contract on IBM stock
- c. Short a two-month forward contract on the S&P 500 index
- d. Answers a. and b. are correct.

**EXAMPLE 13.3: FRM EXAM 2009—QUESTION 3-15**

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Which of the following statements is/are *true* with respect to basis risk?

- I. Basis risk arises in cross-hedging strategies, but there is no basis risk when the underlying asset and hedge asset are identical.
  - II. A short hedge position benefits from unexpected strengthening of basis.
  - III. A long hedge position benefits from unexpected strengthening of basis.
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- a. I and II
  - b. I and III
  - c. II only
  - d. III only

**EXAMPLE 13.4: FRM EXAM 2007—QUESTION 99**

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Which of the following trades contain mainly basis risk?

- I. Long 1,000 lots Nov 07 ICE Brent Oil contracts and short 1,000 lots Nov 07 NYMEX WTI Crude Oil contracts
  - II. Long 1,000 lots Nov 07 ICE Brent Oil contracts and long 2,000 lots Nov 07 ICE Brent Oil at-the-money put
  - III. Long 1,000 lots Nov 07 ICE Brent Oil contracts and short 1,000 lots Dec 07 ICE Brent Oil contracts
  - IV. Long 1,000 lots Nov 07 ICE Brent Oil contracts and short 1,000 lots Dec 07 NYMEX WTI Crude Oil contracts
- a. II and IV only
  - b. I and III only
  - c. I, III, and IV only
  - d. III and IV only

**EXAMPLE 13.5: FRM EXAM 2001—QUESTION 86**

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If two securities have the same volatility and a correlation equal to  $-0.5$ , their minimum variance hedge ratio is

- a. 1:1
- b. 2:1
- c. 4:1
- d. 16:1

**EXAMPLE 13.6: FRM EXAM 2007—QUESTION 125**

A firm is going to buy 10,000 barrels of West Texas Intermediate Crude Oil. It plans to hedge the purchase using the Brent Crude Oil futures contract. The correlation between the spot and futures prices is 0.72. The volatility of the spot price is 0.35 per year. The volatility of the Brent Crude Oil futures price is 0.27 per year. What is the hedge ratio for the firm?

- a. 0.9333
- b. 0.5554
- c. 0.8198
- d. 1.2099

**EXAMPLE 13.7: FRM EXAM 2009—QUESTION 3-26**

XYZ Co. is a gold producer and will sell 10,000 ounces of gold in three months at the prevailing market price at that time. The standard deviation of the change in the price of gold over a three-month period is 3.6%. In order to hedge its price exposure, XYZ Co. decides to use gold futures to hedge. The contract size of each gold futures contract is 10 ounces. The standard deviation of the gold futures price is 4.2%. The correlation between quarterly changes in the futures price and the spot price of gold is 0.86. To hedge its price exposure, how many futures contracts should XYZ Co. go long or short?

- a. Short 632 contracts
- b. Short 737 contracts
- c. Long 632 contracts
- d. Long 737 contracts

### **EXAMPLE 13.8: DURATION HEDGING**

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What assumptions does a duration-based hedging scheme make about the way in which interest rates move?

- a. All interest rates change by the same amount.
- b. A small parallel shift occurs in the yield curve.
- c. Any parallel shift occurs in the term structure.
- d. Interest rates' movements are highly correlated.

### **EXAMPLE 13.9: HEDGING WITH EURODOLLAR FUTURES**

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If all spot interest rates are increased by one basis point, a value of a portfolio of swaps will increase by \$1,100. How many Eurodollar futures contracts are needed to hedge the portfolio?

- a. 44
- b. 22
- c. 11
- d. 1,100

**EXAMPLE 13.10: FRM EXAM 2007—QUESTION 17**

On June 2, a fund manager with USD 10 million invested in government bonds is concerned that interest rates will be highly volatile over the next three months. The manager decides to use the September Treasury bond futures contract to hedge the portfolio. The current futures price is USD 95.0625. Each contract is for the delivery of USD 100,000 face value of bonds. The duration of the manager's bond portfolio in three months will be 7.8 years. The cheapest-to-deliver (CTD) bond in the Treasury bond futures contract is expected to have a duration of 8.4 years at maturity of the contract. At the maturity of the Treasury bond futures contract, the duration of the underlying benchmark Treasury bond is nine years. What position should the fund manager undertake to mitigate his interest rate risk exposure?

- a. Short 94 contracts
- b. Short 98 contracts
- c. Short 105 contracts
- d. Short 113 contracts

**EXAMPLE 13.11: FRM EXAM 2004—QUESTION 4**

Albert Henri is the fixed income manager of a large Canadian pension fund. The present value of the pension fund's portfolio of assets is CAD 4 billion while the expected present value of the fund's liabilities is CAD 5 billion. The respective modified durations are 8.254 and 6.825 years. The fund currently has an actuarial deficit (assets < liabilities) and Albert must avoid widening this gap. There are currently two scenarios for the yield curve: The first scenario is an upward shift of 25bp, with the second scenario a downward shift of 25bp. The most liquid interest rate futures contract has a present value of CAD 68,336 and a duration of 2.1468 years. Analyzing both scenarios separately, what should Albert Henri do to avoid widening the pension fund gap? Choose the best option.

- | First Scenario          | Second Scenario       |
|-------------------------|-----------------------|
| a. Do nothing.          | Buy 7,559 contracts   |
| b. Do nothing.          | Sell 7,559 contracts. |
| c. Buy 7,559 contracts. | Do nothing.           |
| d. Do nothing.          | Do nothing.           |

**EXAMPLE 13.12: FRM EXAM 2009—QUESTION 3-10**

You have a portfolio of USD 5 million to be hedged using index futures. The correlation coefficient between the portfolio and futures being used is 0.65. The standard deviation of the portfolio is 7% and that of the hedging instrument is 6%. The futures price of the index futures is USD 1,500 and one contract size is 100 futures. Among the following positions, which one reduces risk the most?

- a. Long 33 futures contracts
- b. Short 33 futures contracts
- c. Long 25 futures contracts
- d. Short 25 futures contracts

**EXAMPLE 13.13: FRM EXAM 2007—QUESTION 107**

The current value of the S&P 500 index is 1,457, and each S&P futures contract is for delivery of 250 times the index. A long-only equity portfolio with market value of USD 300,100,000 has a beta of 1.1. To reduce the portfolio beta to 0.75, how many S&P futures contracts should you sell?

- a. 288 contracts
- b. 618 contracts
- c. 906 contracts
- d. 574 contracts

## 13.5 ANSWERS TO CHAPTER EXAMPLES

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### Example 13.1: FRM Exam 2000—Question 79

d. Basis risk occurs if movements in the value of the cash and hedged positions do not offset each other perfectly. This can happen if the instruments are dissimilar or if the correlation is not unity. Even with similar instruments, if the hedge is lifted before the maturity of the underlying, there is some basis risk.

### Example 13.2: FRM Exam 2009—Question 3-14

a. Basis risk is minimized when the maturity of the hedging instrument coincides with the horizon of the hedge (i.e., two months) and when the hedging instrument is exposed to the same risk factor (i.e., IBM).

### Example 13.3: FRM Exam 2009—Question 3-15

c. Basis risk can arise if the maturities are different, so answer I. is incorrect. A short hedge position is long the basis, which means that it benefits when the basis strengthens, because this means that the futures price drops relative to the spot price, which generates a profit.

### Example 13.4: FRM Exam 2007—Question 99

c. There is mainly basis risk for positions that are both long and short either different months or contracts. Position II. is long twice the same contract and thus has no basis risk (but a lot of directional risk).

### Example 13.5: FRM Exam 2001—Question 86

b. Set  $x$  as the amount to invest in the second security, relative to that in the first (or the hedge ratio). The variance is then proportional to  $1 + x^2 + 2xp$ . Taking the derivative and setting to zero, we have  $x = -\rho = 0.5$ . Thus, one security must have twice the amount in the other. Alternatively, the hedge ratio is given by  $N^* = -\rho \frac{\sigma_s}{\sigma_f}$ , which gives 0.5. Answer b. is the only one that is consistent with this number or its inverse.

### Example 13.6: FRM Exam 2007—Question 125

a. The optimal hedge ratio is  $\beta_{sf} = \rho_{sf} \frac{\sigma_s}{\sigma_f} = 0.72 \cdot 0.35 / 0.27 = 0.933$ .

**Example 13.7: FRM Exam 2009—Question 3-26**

b. XYZ will incur a loss if the price of gold falls, so should short futures as a hedge. The optimal hedge ratio is  $\rho\sigma_s/\sigma_f = 0.86 \times 3.6/4.2 = 0.737$ . Taking into account the size of the position, the number of contracts to sell is  $0.737 \times 10,000/10 = 737$ .

**Example 13.8: Duration Hedging**

b. The assumption is that of (1) parallel and (2) small moves in the yield curve. Answers a. and c. are the same, and omit the size of the move. Answer d. would require perfect, not high, correlation plus small moves.

**Example 13.9: Hedging with Eurodollar Futures**

a. The DVBP of the portfolio is \$1,100. That of the futures is \$25. Hence the ratio is  $1,100/25 = 44$ .

**Example 13.10: FRM Exam 2007—Question 17**

b. The number of contracts to short is  $N^* = -\frac{(D_s^*S)}{(D_f^*F)} = -(7.8 \times 10,000,000)/(8.4 \times (95.0625) \times 1,000) = -97.7$ , or 98 contracts. Note that the relevant duration for the futures is that of the CTD; other numbers are irrelevant.

**Example 13.11: FRM Exam 2004—Question 4**

a. We first have to compute the dollar duration of assets and liabilities, which gives, in millions,  $4,000 \times 8.254 = 33,016$  and  $5,000 \times 6.825 = 34,125$ , respectively. Because the DD of liabilities exceeds that of assets, a decrease in rates will increase the liabilities more than the assets, leading to a worsening deficit. Albert needs to buy interest rate futures as an offset. The number of contracts is  $(34,125 - 33,016)/(68,336 \times 2.1468/1,000,000) = 7,559$ .

**Example 13.12: FRM Exam 2009—Question 3-10**

d. To hedge, the portfolio manager should sell index futures, to create a profit if the portfolio loses value. The portfolio beta is  $0.65 \times (7\%/6\%) = 0.758$ . The number of contracts is  $N^* = -\beta S/F = -(0.758 \times 5,000,000)/(1,500 \times 100) = -25.3$ , or 25 contracts.

**Example 13.13: FRM Exam 2007—Question 107**

a. This is as in the previous question, but the hedge is partial (i.e., for a change of 1.10 to 0.75). So,  $N^* = -\beta S/F = -(1.10 - 0.75)300,100,000/(1,457 \times 250) = -288.3$  contracts.