EXAMPLE 14.1: FRM EXAM 2006—QUESTION 91

The dividend yield of an asset is 10% per annum. What is the delta of a long forward contract on the asset with six months to maturity?

a. 0.95
b. 1.00
c. 1.05
d. Cannot determine without additional information

EXAMPLE 14.2: FRM EXAM 2004—QUESTION 21

A 90-day European put option on Microsoft has an exercise price of $30. The current market price for Microsoft is $30. The delta for this option is close to

a. −1
b. −0.5
c. 0.5
d. 1

EXAMPLE 14.3: FRM EXAM 2006—QUESTION 80

You are given the following information about a European call option: Time to maturity = 2 years; continuous risk-free rate = 4%; continuous dividend yield = 1%; $N(d_1) = 0.64$. Calculate the delta of this option.

a. −0.64
b. 0.36
c. 0.63
d. 0.64

EXAMPLE 14.4: FRM EXAM 2009—QUESTION 4-27

An analyst is doing a study on the effect on option prices of changes in the price of the underlying asset. The analyst wants to find out when the deltas of calls and puts are most sensitive to changes in the price of the underlying. Assume that the options are European and that the Black-Scholes formula holds. An increase in the price of the underlying has the largest absolute value impact on delta for:

a. Calls deep in-the-money and puts deep out-of-the-money
b. Deep in-the-money puts and calls
c. Deep out-of-the-money puts and calls
d. At-the-money puts and calls

EXAMPLE 14.5: FRM EXAM 2001—QUESTION 79

A bank has sold USD 300,000 of call options on 100,000 equities. The equities trade at 50, the option strike price is 49, the maturity is in three months, volatility is 20%, and the interest rate is 5%. How does the bank delta-hedge?

a. Buy 65,000 shares
b. Buy 100,000 shares
c. Buy 21,000 shares
d. Sell 100,000 shares

EXAMPLE 14.6: FRM EXAM 2006—QUESTION 106

Suppose an existing short option position is delta-neutral, but has a gamma of −600. Also assume that there exists a traded option with a delta of 0.75 and a gamma of 1.50. In order to maintain the position gamma-neutral and delta-neutral, which of the following is the appropriate strategy to implement?

a. Buy 400 options and sell 300 shares of the underlying asset.
b. Buy 300 options and sell 400 shares of the underlying asset.
c. Sell 400 options and buy 300 shares of the underlying asset.
d. Sell 300 options and buy 400 shares of the underlying asset.

EXAMPLE 14.7: FRM EXAM 2009—QUESTION 4-26

Ms. Zheng is responsible for the options desk in a London bank. She is concerned about the impact of dividends on the options held by the options desk. She asks you to assess which options are the most sensitive to dividend payments. What would be your answer if the value of the options is found by using the Black-Scholes model adjusted for dividends?

a. Everything else equal, out-of-the-money call options experience a larger decrease in value than in-the-money call options as expected dividends increase.
b. The increase in the value of in-the-money put options caused by an increase in expected dividends is always larger than the decrease in value of in-the-money call options.
c. Keeping the type of option constant, in-the-money options experience the largest absolute change in value and out-of-the-money options the smallest absolute change in value as expected dividends increase.
d. Keeping the type of option constant, at-the-money options experience the largest absolute change in value and out-of-the-money options the smallest absolute change in value as a result of dividend payment.

EXAMPLE 14.8: FRM EXAM 2004—QUESTION 65

Which of the following statements is *true* regarding options Greeks?

a. Theta tends to be large and positive when buying at-the-money options.
b. Gamma is greatest for in-the-money options with long maturities.
c. Vega is greatest for at-the-money options with long maturities.
d. Delta of deep in-the-money put options tends toward +1.

EXAMPLE 14.9: FRM EXAM 2006—QUESTION 33

Steve, a market risk manager at Marcat Securities, is analyzing the risk of its S&P 500 index options trading desk. His risk report shows the desk is net long gamma and short vega. Which of the following portfolios of options shows exposures consistent with this report?

a. The desk has substantial long-expiry long call positions and substantial short-expiry short put positions.
b. The desk has substantial long-expiry long put positions and substantial long-expiry short call positions.
c. The desk has substantial long-expiry long call positions and substantial short-expiry short call positions.
d. The desk has substantial short-expiry long call positions and substantial long-expiry short call positions.

EXAMPLE 14.10: FRM EXAM 2006—QUESTION 54

Which of the following statements is *incorrect*?

a. The vega of a European-style call option is highest when the option is at-the-money.
b. The delta of a European-style put option moves toward zero as the price of the underlying stock rises.
c. The gamma of an at-the-money European-style option tends to increase as the remaining maturity of the option decreases.
d. Compared to an at-the-money European-style call option, an out-of-the-money European-style option with the same strike price and remaining maturity has a greater negative value for theta.

EXAMPLE 14.11: VEGA AND GAMMA

How can a trader produce a short vega, long gamma position?

a. Buy short-maturity options, sell long-maturity options.
b. Buy long-maturity options, sell short-maturity options.
c. Buy and sell options of long maturity.
d. Buy and sell options of short maturity.

EXAMPLE 14.12: VEGA AND THETA

An option portfolio exhibits high unfavorable sensitivity to increases in implied volatility and while experiencing significant daily losses with the passage of time. Which strategy would the trader most likely employ to hedge the portfolio?

a. Sell short-dated options and buy long-dated options.
b. Buy short-dated options and sell long-dated options.
c. Sell short-dated options and sell long-dated options.
d. Buy short-dated options and buy long-dated options.

EXAMPLE 14.13: FRM EXAM 2005—QUESTION 130

An option on the Bovespa stock index is struck on 3,000 Brazilian reais (BRL). The delta of the option is 0.6, and the annual volatility of the index is 24%. Using delta-normal assumptions, what is the 10-day VAR at the 95% confidence level? Assume 260 days per year.

a. 44 BRL
b. 139 BRL
c. 2,240 BRL
d. 278 BRL

EXAMPLE 14.14: FRM EXAM 2009—QUESTION 4-6

An investor is long a short-term at-the-money put option on an underlying portfolio of equities with a notional value of USD 100,000. If the 95% VAR of the underlying portfolio is 10.4%, which of the following statements about the VAR of the option position is *correct* when second-order terms are considered?

a. The VAR of the option position is slightly more than USD 5,200.
b. The VAR of the option position is slightly more than USD 10,400.
c. The VAR of the option position is slightly less than USD 5,200.
d. The VAR of the option position is slightly less than USD 10,400.

14.5 ANSWERS TO CHAPTER EXAMPLES

Example 14.1: FRM Exam 2006—Question 91

a. The delta of a long forward contract is $e^{-r^*\tau} = \exp(-0.10 \times 0.5) = 0.95$.

Example 14.2: FRM Exam 2004—Question 21

b. The option is ATM because the strike price is close to the spot price. This is a put, so the delta must be close to -0.5.

Example 14.3: FRM Exam 2006—Question 80

c. This is a call option, so delta must be positive. This is given by $\Delta = \exp(-r^*\tau)$ $N(d_1) = \exp(-0.01 \times 2) \times 0.64 = 0.63$.

Example 14.4: FRM Exam 2009—Question 4-27

d. From Figure 14.3, the delta is most sensitive, or gamma the highest, for ATM short-term options. Under the BS model, gamma is the same for calls and puts.

Example 14.5: FRM Exam 2001—Question 79

a. This is an at-the-money option with a delta of about 0.5. Since the bank sold calls, it needs to delta-hedge by buying the shares. With a delta of 0.54, it would need to buy approximately 50,000 shares. Answer a. is the closest. Note that most other information is superfluous.

Example 14.6: FRM Exam 2006—Question 106

a. Because gamma is negative, we need to buy a call to increase the portfolio gamma back to zero. The number is $600/1.5 = 400$ calls. This, however, will increase the delta from zero to $400 \times 0.75 = 300$. Hence, we must sell 300 shares to bring the delta back to zero. Note that positions in shares have zero gamma.

Example 14.7: FRM Exam 2009—Question 4-26

c. OTM call options are not very sensitive to dividends, as indicated in Figure 14.7, so answer a. is incorrect. This also shows that ITM options have the highest ρ^* in absolute value.

Example 14.8: FRM Exam 2004—Question 65

c. Theta is negative for long positions in ATM options, so a. is incorrect. Gamma is small for ITM options, so b. is incorrect. Delta of ITM puts tends to -1, so d. is incorrect.

Example 14.9: FRM Exam 2006—Question 33

d. Long gamma means that the portfolio is long options with high gamma, typically short-term (short-expiry) ATM options. Short vega means that the portfolio is short options with high vega, typically long-term (long-expiry) ATM options.

Example 14.10: FRM Exam 2006—Question 54

d. Vega is highest for ATM European options, so statement a. is correct. Delta is negative and moves to zero as S increases, so statement b. is correct. Gamma increases as the maturity of an ATM option decreases, so statement c. is correct. Theta is greater (in absolute value) for short-term ATM options, so statement d. is incorrect.

Example 14.11: Vega and Gamma

a. Long positions in options have positive gamma and vega. Gamma (or instability in delta) increases near maturity; vega decreases near maturity. So, to obtain positive gamma and negative vega, we need to buy short-maturity options and sell long-maturity options.

Example 14.12: Vega and Theta

a. Such a portfolio is short vega (volatility) and short theta (time). We need to implement a hedge that is delta-neutral and involves buying and selling options with different maturities. Long positions in short-dated options have high negative theta and low positive vega. Hedging can be achieved by selling short-term options and buying long-term options.

Example 14.13: FRM Exam 2005—Question 130

b. The linear VAR is derived from the worst move in the index value, which is $\alpha S\sigma\sqrt{T} = 1.645 \times 3{,}000(24\%/\sqrt{260})\sqrt{10} = 232.3$. Multiplying by the delta of 0.6 gives 139.

Example 14.14: FRM Exam 2009—Question 4-6

c. The delta must be around 0.5, which implies a linear VAR of $\$100{,}000 \times 10.4\% \times 0.5 = \$5{,}200$. The position is long an option and has positive gamma. As a result, the quadratic VAR must be lower than \$5,200.