

The Johns Hopkins Carey Business School

Derivatives

Spring 2010

Instructor: Bahattin Buyuksahin

Final Exam

Final– DUE ON WEDNESDAY, May 19th, 2010

Late submissions will not be graded.

Show your calculations. Do not just report the final numerical answer! Obey page limits.
If a question has multiple parts, indicate exactly where you answer each part.
This exam has five (5) sections; be sure to follow the directions for each section. You can
turn-in hand-written final answers.

The plagiarizing, in any form, of the work of another is a form of academic dishonesty and will result in an automatic failing grade. By the act of submitting written work to satisfy the final assignment, you make the claim that the work is your own.

A. DEFINITIONS: (10 points) (Suggested time: 20 minutes)

ANSWER ALL OF THESE. Carefully define the following terms. Whenever possible, give *both* mathematical and verbal definition.

Page limit: 1/4 page per definition.

European Call Option	Gamma
Delta	Option Elasticity
Rho	Lambda
Exotic Option	Naked Position
Swap	Covered Position

B. TRUE-FALSE: (10 points) (Suggested time: 20 minutes)

ANSWER ALL OF THESE. Please comment the following statements. (True or False). Write down your reason. Each question is equally weighted.

Page limit: 1/4 page per question.

1. A trader sees a Euro call and put with a strike of 40 and an expiration of 6 months. Both sell for \$5. The risk free rate is 10%, the current stock price is 38 and a \$2 dividend is expected in one month. In this case, there is an arbitrage opportunity and the trader should short the put and the stock, and long the call.
2. Given a call price of \$4, $r_f = 6\%$ a stock price of 23 and a strike of 20, with six months to expiration, the implied volatility is 73.23%.
3. A portfolio of derivatives on an asset is worth \$10,000 and the risk-free interest rate is 5%. If the delta and gamma of the portfolio is zero, then the theta of the portfolio is \$500 per year.
4. The volatility of the underlying stock is not directly observable, but can be estimated from historic data. If the implied volatility is lower than the actual volatility of the stock, the option will be overvalued, as the higher the implied volatility, the higher the price of the option.
5. In a six month American call option a dividend is expected at the end of five months. The strike price is \$30 and the risk-free interest rate is 10%. If the dividend is higher than 0.25, then there is some chance of early exercise.

C. MULTIPLE CHOICE: (10 points) (Suggested time: 20 minutes)

ANSWER ALL OF THESE. Please show your work. Answers without explanation will not be accepted.

- 1) Suppose you purchase one IBM May 100 call contract at \$5 and write one IBM May 105 call contract at \$2. Your strategy is called
- a short straddle.
 - a money spread
 - a horizontal straddle.
 - a covered call.
- 2) Portfolio A consists of 150 shares of stock and 300 calls on that stock. Portfolio B consists of 575 shares of stock. The call delta is 0.7. Which portfolio has a higher dollar exposure to a change in stock price?
- Portfolio B
 - Portfolio A
 - The two portfolios have the same exposure
 - A if the stock price increases and B if it decreases.
- 3) If a bearish market with high implied volatility, which might be a prudent strategy:
- buy naked puts;
 - sell the underlying;
 - sell naked calls;
 - buy naked puts and sell naked calls.
- 4) What happens to the price of an out-of-the-money option when uncertainty concerning future volatility increases?
- It rises;
 - It decreases;
 - It remains close to constant;
 - Cannot be determined.
- 5) In a trading situation an early volatility burst pushed the price of the underlying asset away from the initial level and the vega of the option became lower. Subsequent low volatility prevented the price from going back to its initial level and the vega continued to remain low. In such a situation an option writer who wanted to profit from the time decay will experience:
- relatively high positive vega when the realized volatility is high and relatively low negative vega when the realized volatility is low;
 - relatively high negative vega when the realized volatility is low and relatively low negative vega when the realized volatility is high;

- c. relatively stable and constant vega throughout.
- d. relatively high negative vega when the realized volatility is high and relatively low negative vega when the realized volatility is low;

6) A put option is currently selling for \$6 with an exercise price of \$50. If the hedge ratio for the put is -0.30 and the stock is currently selling for \$46, what is the elasticity of the put?

- A. 2.76
- B. -2.30
- C. 2.30
- D. -2.76

7) A volatility smile such as that seen for foreign currency options can be caused by

- a. The fact that currencies are traded in different countries at different times of the day
- b. The fact that volatility is constant
- c. The fact that the activities of central banks causes occasional jumps in the exchange rate
- d. The fact that interest rates may be different in the two countries

8) . Which of the following **cannot** be calculated directly from a binomial tree

- a. vega
- b. delta
- c. gamma
- d. theta

9) An American-style call option with six months to maturity has a strike price of \$35. The underlying stock now sells for \$43. The call premium is \$12. If the risk-free rate is 6%, what should be the value of a put option on the same stock with the same strike price and expiration date?

- A. \$3.00
- B. \$2.02
- C. \$12.00
- D. \$5.25

10) A portfolio consists of 400 shares of stock and 200 calls on that stock. If the hedge ratio for the call is 0.6, what would be the dollar change in the value of the portfolio in response to a one dollar decline in the stock price?

- A. +\$700
- B. +\$500
- C. -\$580
- D. -\$520

D. SHORT QUESTIONS: (66 points) (Suggested time: 120 minutes)

ANSWER Question 1 and 2 and one question from each from question 3 to 5, a total of 5 Questions. Please show your work. Answers without derivation will not be evaluated.

Question 1 (Binomial Model, 22 points)

A stock price is currently 100. In any year, the price can increase by a factor of 1.25, or fall by a factor of .75. The stock pays no dividends.

- a. Find the value of both European and American call options with strike prices of 100 and maturities of 2 years. The risk-free rate is 10%.
- b. Find the value of both European and American put options with strike prices of 100 and maturities of 2 years. The risk-free rate is 10%.
- c. Is the put-call parity relation satisfied by the European options? The American ones? Would you predict that the American put price will be higher than its parity value in general? Explain.
- d. Solve (a) and (b) again, now assuming that the risk-free rate is zero. Explain intuitively why early exercise is no longer an issue for puts. Confirm put-call parity.
- e. Return to a risk-free interest rate of 10%.
 - i. Calculate the hedge ratio for the call option after the first year (i.e., at $t = 1$) at both possible values for the stock price. Explain intuitively why the hedge ratio is higher when the stock price is higher.
 - ii. Calculate the hedge ratio for the put option after the first year at both possible values for the stock price. Explain intuitively why the hedge ratio is higher (in absolute value) when the stock price is lower.
 - iii. Why does the put's hedge ratio equal -1.0 when the stock price is at 75?

Question 2 (11 points)

- a) The price of non-dividend paying stock is \$55 per share. A 6-month, at the money call option is trading for \$1.89. If the interest rate is 6.5%, what is the likely price of a European put at the same strike and expiration?
- b) Suppose that a \$60 strike call has 45 days until expiration and pays a 1.5% continuous dividend. Assume $S = \$58.5$, volatility is 0.25 and $r = 0.06$. What is the option elasticity given an immediate price increase of \$1.5.
- c) Compute delta for the following call option. The stock is selling for \$23.5. The strike price is \$25. The possible stock prices at the end of 6 months are \$27.25 and \$21.75. (Do not assume equal probabilities).

- d) Assume that a \$75 strike call has a 1% continuous dividend, 90 days until expiration, and stock price of \$72.00. What is the rho of the option as the interest rate changes from 6% to 5%.

Answer one of the following questions (11 points)

Question 3a

Six-month call options with strike prices of \$35 and \$40 cost \$6 and \$4, respectively.

- What is the maximum gain when a bull spread is created from the calls?
- What is the maximum loss when a bull spread is created from the calls?
- What is the maximum gain when a bear spread is created from the calls?
- What is the maximum loss when a bear spread is created from the calls?

Question 3b

Three-month European put options with strike prices of \$50, \$55, and \$60 cost \$2, \$4, and \$7, respectively.

- What is the maximum gain when a butterfly spread is created from the put options?
- What is the maximum loss when a butterfly spread is created from the put options?
- For what two values of S_T does the holder of the butterfly spread breakeven with a profit of zero, where S_T is the stock price in three months?

Answer one of the following questions: (11 points)

Question 4a

The exchange rate is ¥95/€, the yen-denominated interest rate is 1.5%, the euro denominated interest rate is 3.5%, and the exchange rate volatility is 10%.

- What is the price of a 90-strike yen-denominated euro put with 6 months to expirations. (1 point)
- What is the price of a 1/90-strike euro-denominated yen call with 6 months to expirations. (1 point)
- What is the link between your answer to (a) and your answer to (b), converted to yen? (4 points)

Question 4b

Suppose that the exchange rate is 1 dollar for 120 Yen. The dollar interest rate is 5% (continuously compounded) and the yen rate is 1% (continuously compounded). Consider an at the money American dollar call that is yen denominated (i.e., the call permits you to buy 1 dollar for 120 yen). The option has a 1 year to expiration and the exchange rate volatility is 10%. Assume that you are working with three-period binomial tree (including today).

- What is the price of a European call? An American call?
- What is the price of a European put? An American put?
- How do you account for the pattern of early exercise across the two options?

Answer one of the following questions: (11 points)

Question 5a

Companies LL and MM have been offered the following rates per annum on a nominal \$100 M 10-year investment:

	Fixed Rate	Floating Rate
Company LL	5.0%	LIBOR - 0.2%
Company MM	5.8%	LIBOR

- a) Which of the two companies is a better company? Explain.
- b) Company MM requires a floating-rate and company LL requires a fixed-rate. Design a swap that will net a bank, acting as intermediary, 0.2% and it will appear equally attractive to LL and MM.
- c) How the setup of this problem should change if instead of an investment we were dealing with a loan?

Question 5b

Company A, a British manufacturer, wishes to borrow U.S. Dollar at a fixed rate of interest. Company B, a U.S. multinational, wishes to borrow sterling at a fixed rate of interest. They have been quoted the following rates per annum.

	Sterling	U.S. Dollar
Company A	11.0%	7.0%
Company B	10.6%	6.2%

Design a swap that will net a bank, acting as intermediary, 10 basis points per annum for each of the companies.

E. LONG QUESTIONS: (4 points) (Suggested time: Unlimited)

1. How many hours did you spend for this exam?
2. If you are asked to grade the difficulty of this exam, what will be your grade? (1 is very easy, 2 is easy, 3 is moderate, 4 is difficult, 5 is very difficult)
3. What grade are you expecting from this exam (give me a range not greater than 10; i.e you can say I expect to get between 80 and 90)?
4. After this exam, if you are given the chance to choose between take-home and in-class final exam, which one will you choose?