Johns Hopkins University

Carey Business School

Derivatives Pricing

Fall 2009

Instructor: Bahattin Buyuksahin

Homework 2

ASSIGNMENT – DUE ON November 25th, 2009

Show your work. Do NOT just apply formulae. The focus of the homework is not on right or wrong numerical answers. Instead, the emphasis is on your ability to demonstrate your solid understanding of the concepts, and your ability to apply the concepts to real data. Numerical accuracy is less important than the reasoning and narrative. In general the answers must be complete and demonstrate a clear and full understanding of the concepts or parameters being described.
Your work will be evaluated based on overall quality and presentation.

IMPORTANT: This is an individual assignment. University regulation on plagiarism will be applied.

Question 1 (10 points)

a) What are the problems of Black-Scholes pricing models?

b) Why the price of call option is always higher than that of put option?

Question 2 (9 points)

Explain and show the profiles of the following strategies: (you can assume parameters by yourself on your graphs)

a) Straddle
b) Butterfly Spread
c) Strip and Strap.

Question 3 (15 points)

Please calculate the implied volatilities based on the following data:

Index Price	Strike Price	Call price	T	Interest Rate
US$8,918	US$8,700	$416	26 days	2.50%
US$8,918	US$8,800	$356	26 days	2.50%
US$8,918	US$8,900	$300	26 days	2.50%
US$8,918	US$9,000	$255	26 days	2.50%
US$8,918	US$9,100	$215	26 days	2.50%

Question 4 (15 points)

The price of an American call on a non-dividend paying stock is $2. The stock price is $31, the strike price is $30, and the maturity is in 6 months. The risk-free rate of interest is 4%.

a) Derive upper and lower bounds for the price of the price of an American put on the same stock with the same strike price and expiration date. (10 points)

b) Explain the arbitrage opportunities available to an arbitrageur if the American put price is greater than the calculated upper bound. (5 points)

Question 5 (12 points)
Draw a diagram showing the variation of investor's profits and losses for the terminal value of a portfolio consisting of:

a) One share and a short position in a call option. Explain. (4 points)

b) Two shares and a short position in a call option. Explain. (4 points)

c) One share and a short position in two call options. Explain. (4 points)

In each case assume that the call option has an exercise price equal to the current stock price.

Question 6 (12 points)
Assume that a stock price is currently trading at $50. It is known that at the end of 6 months it will be either $60 or $42. The risk-free rate is 10% (continuous compounding).

a) Compute the value of a European call option on the stock with an exercise price of $48 and a 6-months maturity. [Hint: use the binomial tree (no arbitrage argument)] (6 points)

b) Verify that no-arbitrage arguments (binomial tree) and risk-neutral valuation arguments give the same answer. Explain why this is the case. (6 points)

Question 7 (15 points)
Consider a European call option on a non-dividend paying stock where the stock price is $40, the strike price is $40, the risk-free rate is 4% per annum, the volatility is 30% per annum, and the maturity is 6 months.

a) Compute u, d, and p for a two-step tree. (6 points)

b) Value the option using a two-step tree. (4 points)

c) Explain how the binomial tree techniques work and what the underline assumptions are. (5 points)

Question 8 (12 points)
Using the Black-Scholes pricing model, compute the price of a European call option and a put option on a non-dividend paying stock. The current stock price is $86, the strike price is $87, the risk free rate of interest is 2% per annum, the volatility of the underline stock is 25% per annum, and the time to maturity is 20 days. [Hint. Compute d_1, d_2, $N(d_1)$ and $N(d_2)$ using the table in the book.]