The Johns Hopkins Carey Business School

Financial Risk Management

Fall 2009

Instructor: Bahattin Buyuksahin

Final Exam

FINAL– DUE ON Thursday, December 17th, 2009 (in class, bring a hard copy of your answers, please do not submit electronic copy)

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. Use Times New Roman 12pt in your writing.

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 homework 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.

Gaussian Copula	Implied Volatility
Credit Default Swap	Recovery Rate
Moral Hazard	Settlement Risk
Adverse Selection	Collaterized Debt Obligations
GARCH	Delta-Gamma Method

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. It is better to buy credit default protection from an uncorrelated lower rated credit default protection Seller than from a credit protection Seller, which is highly correlated with the reference asset one is trying to hedge.
2. In fact, the rise in OTC derivatives trading and the lack of post-trade standardization and automation is a cause for serious concern; today, firms grapple with piles of unprocessed transactions, leading to severe breaks in reconciliation, and problems with collateral and exposure management further downstream.
3. Pure jumps in equity prices can be modeled as negative binomial process.
4. You have the opportunity to invest in a portfolio of junk bonds (bonds rated BB or below by Moddy's). The probability of default is high for these bonds. Therefore, the portfolio is very risky and you should demand a high risk premium.
5. Credit risk in the swap market is not limited to the difference between the values of the fixed rate and floating rate obligations.

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) For an asset correlation matrix to be valid and workable:
  a) all eigenvalues of the correlation matrix should be negative;
  b) the determinant of the correlation matrix should be strictly negative;
  c) cholesky matrix should exist;
  d) at least one eigenvalue of the correlation matrix should be negative;

2) The probability of default in the original Merton model can be derived via:
  a) a call option;
  b) a call and a put option;
  c) two put options and a call option
  d) a put option

3) They say that experienced option traders have ***"GARCH in their heads"***. What is generally implied by this statement is that:
  a) memory of past variance is built into trading models;
  b) trading models are independent of past variances;
  c) markets display fat tails
  d) None of the above;

4) Cornish-Fisher expansion takes into account:
  a) the skewness of an empirical distribution;
  b) the kurtosis of an empirical distribution;
  c) both the skewness and the kurtosis of an empirical distribution;
  d) is valid only for a gamma distribution;

5) A credit spread put hedges:
  a) A long position in an asset with respect to credit deterioration risk only;
  b) A long position in an asset with respect to credit deterioration as well as default risk;
  c) A short position in an asset with respect ot credit deterioration as well as default risk;
  d) A short position in an asset with credit deterioration risk only.

6) Assume a decay factor of 0.97 in an exponentially weighted moving average method. A risk manager estimates that the realized volatility of an asset of one period before the present period is 10% and this period's return has been 1%. If this period¡¦s volatility is a fair estimate of next period's volatility then the forecast volatility for the next period for the asset would be:]
  a) 9%
  b) 10%
  c) 11%
  d) 13%

7) A risk manager in a bank wants to capture on very recent volatility behavior (roughly about one month's behavior) in particular asset. He is using an Exponentially Weighted Moving Average method to calculate the historical volatility of the asset. His choice of the decay factor would be then:

a) 0.83;
b) 0.94
c) 0.97;
d) 0.99

8) A portfolio Manager holds gold, Dollar-Yen and Oil with the exposures of $2 million, $3 million and $1million respectively. If the daily volatilities of gold, Yen and Oil are 0.72%, 0.93% and 1.95% and the correlation matrix between the three is given by:

$$\begin{pmatrix} 1 & 0.12 & 0.24 \\ 0.12 & 1 & 0.18 \\ 0.24 & 0.18 & 1 \end{pmatrix}$$

Then the 95% 10-day VaR of the portfolio is:

a) $220,276
b) $125,540
c) $87,633
d) $69,657

9 A portfolio is comprised of two assets A and B, where the correlation between the returns of asset A and B is 0.5. The volatility of asset A is 10% and the volatility of asset B is 20%. The fund manager has invested 25% of his total funds in asset A and the rest in asset B. The volatility of the portfolio is:

a) 12.56
b) 16.39
c) 18.50
d) 22.35

10) Consider a portfolio with a one-day VAR of $5 millions. Assume that the market is trending with an autocorrelation of 0.5. Under this scenario, what would you expect the two-day VAR to be?

a) $8.66 million
b) $10 million
c) $7.07 million
d) $15 million

D. SHORT QUESTIONS: (66 points) (Suggested time: 120 minutes)
ANSWER Question 1 and one question from each 6 Questions. Please show your work. Answers without derivation will not be evaluated.

Question 1

You observe two call options on the same stock that appear to be relatively mispriced. Call ABC sells for $3.50, has a strike price of X = 50, and an implied volatility from the Black-Scholes model of 30%. Call XYZ sells for $.75, has a strike price of X = 60, and an implied volatility of 25%. You wish to create a delta-neutral position on these options that will exploit the apparent inconsistency in implied volatilities.

a. Suppose you believe that the Black-Scholes model is the correct model for valuing options. Which option will you buy? Which will you sell?

b. If you buy and sell equal numbers of the two options, will your portfolio be delta neutral? If not, which option will require a bigger position (i.e., a purchase or sale of a greater number of contracts) to establish a delta-neutral portfolio?

c. Suppose the stock price is currently S = 50. Which option has the higher gamma? If the price increases by a large amount, will a delta-hedged position suffer a loss, or enjoy a gain, despite its currently market-neutral position?

d. If you believe that stock prices are vulnerable to infrequent, but large downward jumps, how would this affect your interpretation of the relative implied volatilities of the options. Would your conclusion in part (a) be affected?

Answer one of the following questions:

Question 2a

A Value at Risk model assumes that the portfolio return over short periods is approximately normally distributed, with a 6 % annual mean rate of return, and annual standard deviation of 20%. The initial value of the portfolio is $1 million. If you look up the table of the normal distribution, you will find that the 1 percentile score is approximately $Z = -2.33$.

a. What is the one-*month* 1% VaR predicted by your model?

b. What is the one-*week*, 1% VaR? Is its magnitude (i.e., absolute value) more or less than one-fourth of the magnitude of the one-month VaR? Why?

c. Will the VaR be higher or lower if you assume that the actual stock price distribution has fat tails or allows for jumps? Explain briefly.

Question 2b

A Monte Carlo model assumes that the portfolio return over short periods is approximately normally distributed, with an 8% annual mean rate of return, and annual standard deviation of 30%. The initial value of the portfolio is $1 million. When simulating possible stock price paths, the first draw from Excel's standard normal random variable function gives a value of $Z = 1.2$. If the length of the time period in your model is one month, then what is the assumed value of the portfolio at the end of that first month?

Answer one of the following questions:

Question 3a

A firm offers portfolio insurance on a $10 million portfolio with a beta relative to the S&P 500 of $\beta = 1.10$. The insurance program has a 4-year horizon However, the portfolio insurance comes with a "deductible": rather than guaranteeing no losses, the firm promises that losses on the portfolio will not exceed 3% of its initial value. The risk-free rate is 3%, and the firm believes market volatility is $\sigma = 30\%$. The product is provided on an overlay basis: in other words, the portfolio is fully invested in stock and the firm sells futures contracts to reduce overall delta to the appropriate level.

How many S&P 500 contracts should the firm sell today if the Index currently is at 1000? The futures contract multiplier is $250. Assume that one may sell fractional quantities of the futures contract. [You may assume that the futures contract expires very shortly, so that tailing the hedge is not an issue.]

Question 3b

Salomon Brothers believes that market volatility will be 20 percent annually for the next 3 years. 3-year at-the-money put options on the market index sell at an implied volatility of 18 percent. What position in puts and shares can Salomon Brothers establish to speculate on its volatility belief without taking a bullish or bearish position on the market? 3-year at-the-money options have $N(d_1) = .6$.

a. If the value of the stock index increases, should Salomon buy or sell shares to maintain its hedged position?

b. If the market index moves by a large amount, will Salomon Brothers suffer a loss, or enjoy a profit, despite its presumed market-neutral position?

c. Is the theta of Salomon Brothers' position positive or negative?

Answer one of the following questions:
Question 4a

You would like to be holding a protective put position on shares of the XYZ mutual fund to lock in a guaranteed minimum value of $100 per share. XYZ shares currently sell for $100. In each of the next *two* periods, the portfolio will increase by 10% or decrease by 10%. The T-bill rate is 5% per period. Unfortunately, no put options are traded on mutual fund shares.

a. Suppose the desired put option were traded. How much would it cost to purchase?

b. What would have been the cost of the protective put portfolio?

c. Derive the dynamic hedge strategy at time 0 (today) and time 1 (next period) that will provide a payoff equal to that of a protective put with X = $100. Your time-1 strategy will depend on the stock price at that time.

Question 4b

XYZ Corp. sells for $50 and pays no dividends. A 6-month call option with exercise price $50 sells for $3.578, while a 6-month call option with exercise price $55 sells for $2.198. The risk-free rate is 6% per year.

a. What is the implied volatility of these two options?

b. Knowing nothing else about these securities, what might be a reasonable trading strategy given your answer to (a)? [A range of strategies may be justified here.]

c. Suppose that in one month, both options are priced with implied volatilities of 22.5%, and that XYZ is now selling for $49. What should you do? What was your dollar profit over the month?

Answer one of the following questions:

Question 5a

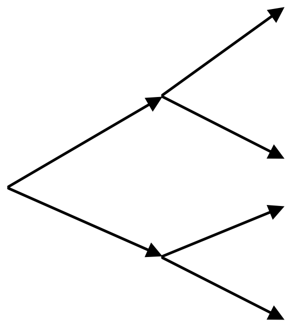
Consider a European call option on a stock when there are ex-dividend dates for 2003 in two months and five months. The dividend on each ex-dividend date is expected to be 0.50%. The current share price is $40 and the strike price is $45. The stock price volatility is 28% per annum and the risk free rate is 5.13% per annum, the volatility is continuously compounded, the interest rate is a simple interest rate, the time to maturity is six months. Calculate the call option's price and delta using Black-Scholes/Merton.

Question 5b

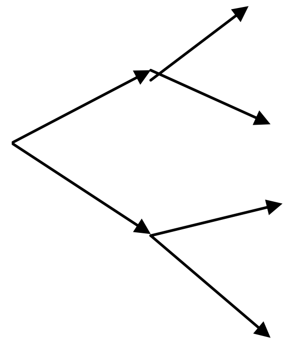
A stock price is currently $ 10. Over each of the next two three-month periods it is expected to go up by 10 percent or down by 10 percent. The risk- free interest rate is 6.184 percent per annum, the interest rate is a simple interest rate (use continuous compounding to get proper r_f). The strike price is $ 10.

Enter the values for the spot price process in the left tree (show all calculations). Enter at each node the stock price in the upper number and the option price in the lower number:

Enter the terminal values of the call in the right tree below. Calculate the option price at the initial node of the tree.



Spot



Option

Answer one of the following questions:

Question 6a

Consider the following GARCH (1,1) model:

$$r_t = \mu + \varepsilon_t$$
$$\varepsilon_t = h_t^{1/2} e_t$$
$$e_t \sim N(0,1)$$
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta h_{t-1}$$

Suppose that the parameters in a GARCH(1,1) model are α_1=0.05, β=0.90 and α_0=0.000005.

a) What is the long-run average volatility?
b) If the current volatility is 2% per day, what is your estimate of the volatility in 10, 20 and 30 days?
c) What volatility should be used to price 10-, 20- and 30-day options?
d) Suppose there is an event that decreases the current volatility by 0.5% to 1.5% per day. Estimate the effect on the volatility in 10, 20 and 30 days.
e) Estimate by how much does the event increase the volatilities used to price 10-, 20- and 30-day options?

Question 6b

Assume that the price of domestic currency in terms of the price of foreign currency follows the process

$$dS = (r_f - r_d)Sdt + \sigma S \varepsilon \sqrt{dt}$$

Where r_f is the foreign risk free rate and r_d is the domestic interest rate. Consider the function

$$G = S(e^{(r_d - r_f)(T-t)} - 1)$$

a) Compute the process for G.

b) An option on the currency can be written as a function of S and time: *f(S,t)*. Compute the process for *f*. Assume that dynamics of S is given by

$$dS = (r_f - r_d)Sdt + \sigma S\varepsilon\sqrt{dt}$$

Comment on your results

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?