Alessandro Beber

Caput Derivatives

Sample Final Exam

NAME: _____

The rules of this exam are as follows.

- Please write your full name above.
- There are xx pages in this exam including this page. Questions start on Page 2 and end on Page xx. The last four pages are empty and are to be used for rough work.
- Please return all the pages when you turn in your exam.
- This is a **closed books closed notes** exam and the exam duration is **2.0** hours.
- You are allowed to use an A4/letter size cheat-sheet, **handwritten**, **one side only**.
- Ordinary calculators are permitted, but no computers or other devices.
- Show as much of your intermediate work as possible, but make sure it is clear what your ultimate answer is.
- Please answer in the space provided as far as possible.
- All problems are compulsory (no options!) - so attempt all problems you can.
- Explain any notation you use clearly.
- **If a question seems unclear, interpret it as best you can and proceed. Do not contact me or anyone else seeking clarification.**
- In addition, the following statement should appear, followed by your signature.

This examination is my own original work. No other person was consulted in answering the questions. Nor have I assisted any other student taking this examination. I am bound by the terms of the University of Amsterdam Student Code of Conduct and I understand that any deviation from that code will be dealt with according to the School's Student Disciplinary Procedures, which includes the potential for expulsion for acts of cheating, plagiarism, or collusion in such acts.

Signed: _____

Good luck!!

1. True or False? Please answer if the following statements are true or false and explain your answer fully. If parts of statement are true but other parts false, the answer should be False. **No credit will be provided for an answer than is not substantiated by a valid explanation.**

(a) A trader owns a portfolio of options that is delta-hedged. Since an options book always gains from convexity, he should never try to hedge the gamma of his position.

(b) When a forward contract is traded on an individual stock and the stock pays a dividend before expiration of the contract, we expect to see the forward price drop by approximately the amount of the dividend the moment the share goes ex-dividend.

(c) When a member of a futures exchange sells short futures contract, she obtain the sale price (multiplied by the number of sold contracts and by the value of each of them) in cash and can withdraw those funds immediately from the margin account.

2. Miscellaneous Questions:

(a) Consider a three-month European call option on ABC stock whose strike price is not fixed but will be equal to 90% of the stock price at maturity. Suppose that ABC stock is currently trading at $100. Suppose also that no dividends are expected on the stock over the next three months and that there are no transaction costs.
What must be the arbitrage-free value of this call?

(b) Assume that the Black-Scholes model holds. You are a major options marketmaker for ABC stock, which is trading for $143, has a 70% volatility and pays no dividends. You have a position in dozens of individual options and the stock with a net value of $30,000,000. The borrowing and lending rate is 7% (annualized and continuously compounded). Your stock holding is such that it exactly offsets the net delta of all the options. Your total gamma is -1,725.
How much do you expect the value of these positions to be one day from now if the stock price remains unchanged? Explain the economic intuition behind your answer.

3. Numerical Questions: The following questions may require you to do some numerical computations. Please state all your step-by-step computations. No credit will be provided if the answer is not substantiated by these step-by-step computations. Partial credit will be provided for correct intermediate steps and for answers that are incorrect merely due to calculation errors.

(a) Describe in great detail your approach to create **synthetically** (i.e. using **only** the underlying and borrowing/lending) a long strangle strategy in a two periods binomial setting.

Assume that you will be trading a non-dividend paying stock currently quoted at $50. The continuously compounded returns on this stock are normally distributed, with an annual mean of 12% and an annual standard deviation of 25%. The annual risk free rate is 10%, constant and at the same level for all the maturities (for your convenience use annual compounding).

You will be replicating options with a one-year time to maturity and strike prices of $40 and $60 dollars.

Notes:

- I want to understand exactly what you are doing in each period. Please show all the details.
- Should you need any time-convention, use one year of 360 days, 30 days per month, where one semester is 0.5 years;
- you should check that what you did was correct by showing that the payoffs of the synthetic strangle at maturity are actually consistent with what you think of a strangle strategy.

4. Analytical Questions: The following questions require no numerical computations. They require you to provide analytical answers, i.e., using symbols or portfolio strategies only. Please state all your steps. No credit will be provided if the answer is not substantiated by these intermediate steps. Partial credit will be provided for correct intermediate steps.

(a) Assume that there are three call options on an underlying with the same maturity but different strike prices K1, K2, and K3, where K2 = 0.5(K1 + K3).

i. Does the butterfly inequality or the convexity restriction for European calls, C(K2) <= 0.5 C(K1) + 0.5 C(K3), hold if the underlying is paying a dividend D at some time-point before the maturity of the options? If yes, prove your answer. If no, explain why.

ii. Does the butterfly inequality or the convexity restriction, C(K2) <= 0.5 C(K1) + 0.5 C(K3), hold if these options are American options instead? If yes, prove your answer. If no, explain why.

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