UCLA Anderson School of Management
Daniel Andrei, Option Markets 232D, Fall 2012

Mock Midterm

Thursday, November 1, 2012

Your Name: _____

Your Signature:[1] _____

- This exam is open book, open notes. You can use a calculator, but be sure to show or explain your work.
- You cannot use a computer. You are not allowed to communicate with anyone (verbally, in writing, or electronically), except for me, during the exam period.
- You may present calculations in non-reduced form (e.g., as "$e^{0.095} - 1$").
- If you are stuck on something, make an assumption, tell me what it is, and do the best you can. I give partial credit if you provide enough correct information.

TIME LIMIT: 1 hour and 15 minutes

TOTAL POINTS: 100

[1] As a member of the UCLA Anderson academic community, the highest standards of academic behavior are expected of you. It is your responsibility to make yourself aware of these standards (specifically regarding plagiarism, individual work, and team work) and adhere to them.

By signing the exam: (*i*) you certify your presence, and (*ii*) you state that you neither gave nor received help on the exam.

1 Answer the following questions.

a. (5 points) The effective annual interest rate is 9.5%. What is the equivalent continuously compounded interest rate?

Interest rate

b. (5 points) A stock has an annual volatility of 42%. What is the 4-week volatility?

4-week volatility

Assume the following for problems 2 and 3:

a. The stock price is \$100.

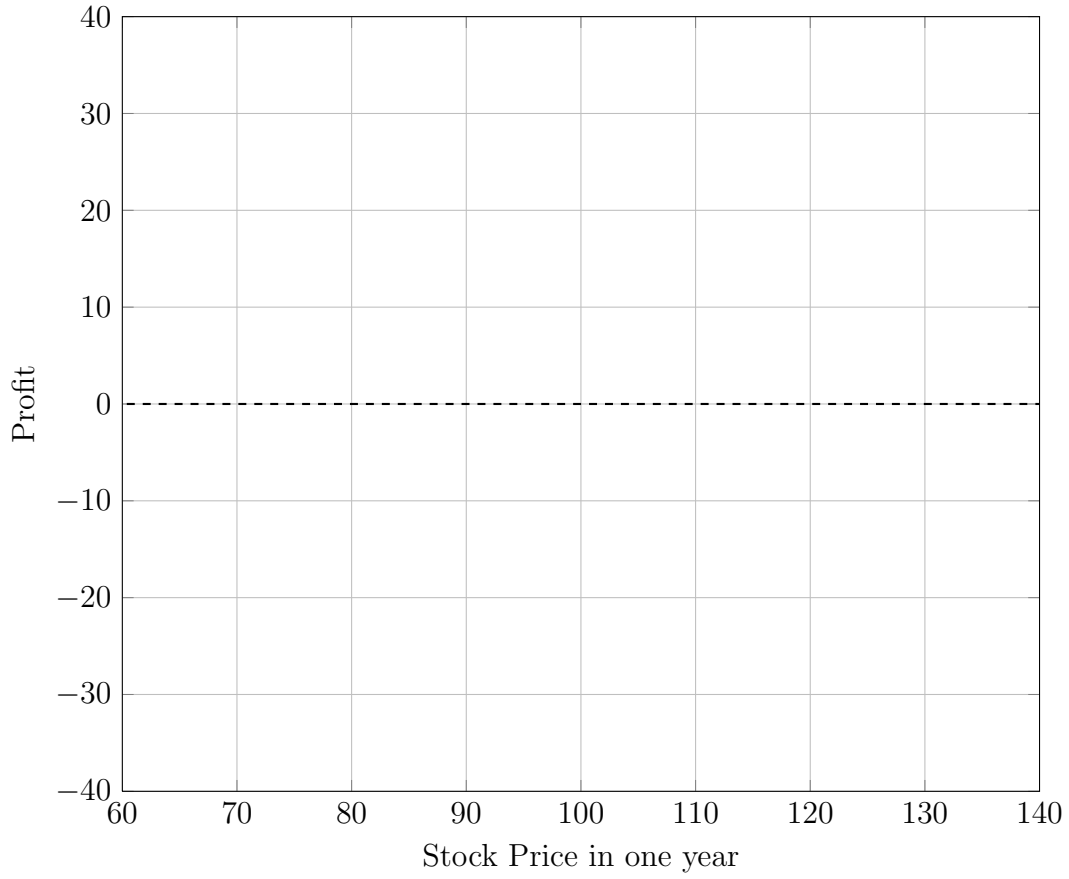
b. The **effective** annual risk-free rate is 10%. This means that if you invest \$1, after one year you will have \$1.10.

c. Here are option prices for you to use as necessary (these are Black-Scholes prices for options with one year to maturity):

Strike	80	90	100	110	120
Calls	29.15	22.24	16.49	11.92	8.44
Puts	1.88	4.06	7.40	11.92	17.53

2 (10 points) Using the interest rate and option information above, explain what option transaction you could use to create a synthetic long forward contract. Explain why this position is equivalent to a long forward contract.

3 a. (10 points) Draw a **profit** diagram for the following position: buy one 90-strike call, buy one 110-strike put.



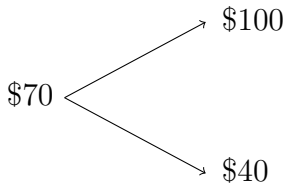
b. (10 points) What is the height of the profit graph when $S = \$100$?

Height at \$100

c. (15 points) Find the stock price(s) at which the position intersects the x-axis (i.e., the position has zero profit).

Point(s) of zero profits

4 Below is a 1-period binomial stock price tree with $h = 1$. The risk-free rate and dividend yield are zero and the risk-neutral probability of an up move is 0.5.



a. (10 points) What is the price of an European 100-strike put?

European Put Price

b. (10 points) What is the price of an American 100-strike put?

American Put Price

c. (5 points) If we assume that the risk-free rate takes a strictly positive value, the American put is more valuable than the European put (no justification necessary).

True: ☐ **False:** ☐

5 Suppose you hold a call option portfolio with the following characteristics (a "1" means the option has been purchased, "-1" that it has been written):

Quantity	1	-1
Strike	100	105
Price	5.5416	3.4447
Delta	0.5488	0.4002
Gamma	0.0305	0.0297
Vega	0.3429	0.3346
Theta	-0.0107	-0.0102
Rho	0.3701	0.2743
Psi	-0.4116	-0.3001
Elasticity	9.9037	11.6171

a. (5 points) Approximately how much will the value of the position change if the stock price changes by $1.50?

Change in value

b. (5 points) How much will the value of this position change if there is a one percentage point change in the interest rate?

Change in value

c. (5 points) If the underlying stock has a beta of 1.25, what is the beta of the 100-strike option?

Option beta

d. (5 points) How many shares of stock would you hold to delta-hedge this position?

Number of shares

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Solutions to Mock Midterm

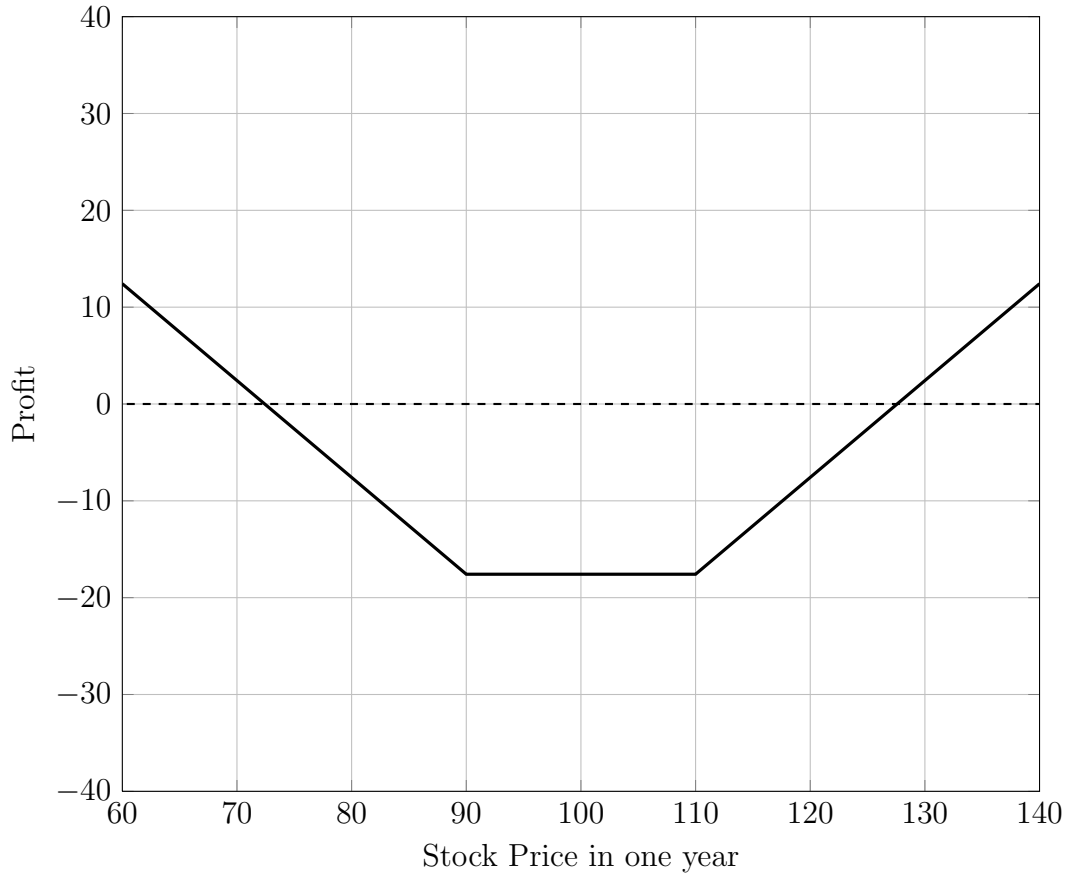
A general comment: if you got the wrong answer and failed to show your work, there was no way to give partial credit. Please keep this in mind for the final exam.

1 a. $\ln(1.095) = 0.0908$. You can check this by verifying that $e^{0.0908} = 1.095$.

b. The 4-week volatility is $0.42 \times \sqrt{4/52} = 0.1165$.

2 Buy the 110 strike call and sell the 110 strike put. This is equivalent to a forward because it requires no initial investment and you will buy the stock after one year: If $S > 110$ you exercise the call and if $S < 110$ the put is exercised.

3 a. The picture is identical to that of a strangle. The cost of the two options is \$34.16, with a future value of $34.16 \times 1.1 = 37.58$.



b. When $S = \$100$, both options are \$10 in the money, hence the profit is -17.58. The profit calculation at \$100 is

$$-\$34.16 \times 1.1 + \max(0, 100 - 90) + \max(0, 110 - 100) = -17.58$$

c. There are two zero-profit points.

- The first point corresponds to the situation where the put option is in-the-money and the call option is out-of-the-money. This point solves the following equation:

$$-\$34.16 \times 1.1 + (110 - x) = 0$$
$$x = \$72.42$$

- The second point corresponds to the situation where the call option is in-the-money and the put option is out-of-the-money. This point solves the following equation:

$$-\$34.16 \times 1.1 + (x - 90) = 0$$
$$x = \$127.58$$

4 a. The price of the European put option is $e^{-r}[0.5 \times \max(0, 100 - 100) + 0.5 \times \max(0, 100 - 40] = 30$.

b. The price of the American put option is also \$30 (we are indifferent about exercise). Ordinarily, if you have a put on a non-dividend-paying stock and if that put is sure to be exercised eventually, then early-exercise will be optimal. But with a zero risk-free rate, the benefit to early exercise (earning interest on the strike price) is zero.

c. True. Any positive risk-free rate will induce early exercise.

5 a. The position delta is

$$\text{Position delta} = 0.5488 - 0.4002 = 0.1486$$

So the change in the position value is $\$1.50 \times 0.1486 = 0.223$

b. Compute the difference in rhos:

$$0.3701 - 0.2743 = 0.0958$$

So the position value will increase by \$0.0958

c. The beta of the option is elasticity times the beta of the stock, or

$$\beta_{\text{Option}} = 1.25 \times 9.9037 = 12.380$$

d. Again, the position delta is

$$\text{Position delta} = 0.5488 - 0.4002 = 0.1486$$

So you would go *short* 0.1486 shares.