FEMBA – Final Exam

November 2013

Date: ──────────────────────────

Your Name: ──────────────────────

Your Equiz.me email address: ──────────────

Your Signature:[1] ──────────────────

- This exam is open book, open notes. You can use a calculator or a computer, but be sure to show or explain your work.

- 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 30 minutes

TOTAL POINTS: 100

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[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 (35 points) Answer the following questions.

   a. (5 points) Which Greek is also called time decay and why?

   b. (5 points) What is the difference between implied volatility and historical volatility?

   c. (5 points) Name some advantages that futures contracts have over forward contracts.

   d. (5 points) Explain the impact of an increase in the dividend yield on the price of a call option.

e. (5 points) The S&P 500 Index is priced at $950.46. The annualized dividend yield on the index is 1.40%. The continuously compounded annual interest rate is 8.40%. What is the price of a forward contract that expires 9 months from today?

f. (5 points) Assume that **effective** annualized zero-coupon bond yields are 5.2%, 5.5%, and 5.8% in years 1,2, and 3, respectively. Find the prices of zero-coupon bonds with maturities in 1,2, and 3 years.

g. (5 points) Assume that corn forward prices for the proceeding 3 years are $2.10, $2.20, and $2.35, respectively. Given the prices of zero-coupon bonds obtained in the previous question, what is the 3-year swap price for corn?

2 (20 points) Below is a **payoff** diagram for a position. All options have 1 year to maturity and the stock price today is $100. The yearly interest rate (**continuously compounded**) is 8%. The underlying asset (the stock) is not paying any dividends.

Stock price in one year
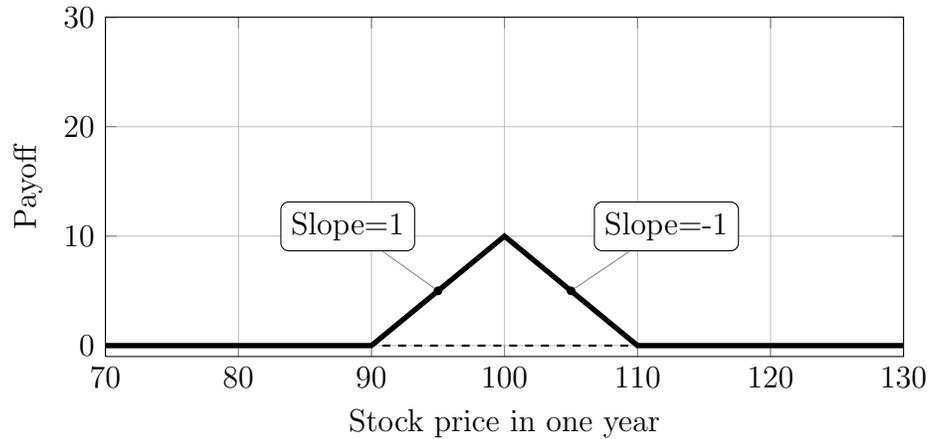
a. (5 points) In the table below, record option quantities which construct the diagram. **Options given in the table have the corresponding strike in parenthesis**. Slopes are marked on the diagram. Denote a purchased position with "+" and a written position with "−".

Option	Call(90)	Call(100)	Call(110)
Position			

b. (5 points) In the table below, record option quantities which construct the diagram. Options given in the table have the corresponding strike in parenthesis. Slopes are marked on the diagram. Denote a purchased position with "+" and a written position with "−".

Option	Put(90)	Put(100)	Put(110)
Position			

c. (5 points) Can the portfolio corresponding to the above payoff have zero or negative initial premium? Why or why not?

d. (5 points) How is this strategy commonly called? Discuss its benefits and disadvantages.

3 (30 points) Donald Trump offers to give you a partnership share in his casinos if the price of this share drops below $100 in one year from now. The share price today is $100. In other words, you are being offered an **asset-or-nothing put**. Donald Trump charges a nominal fee of $26.86 for this option and you would like to know if he is charging the right price.

    a. (5 points) Draw the **payoff** diagram for the asset-or-nothing put.
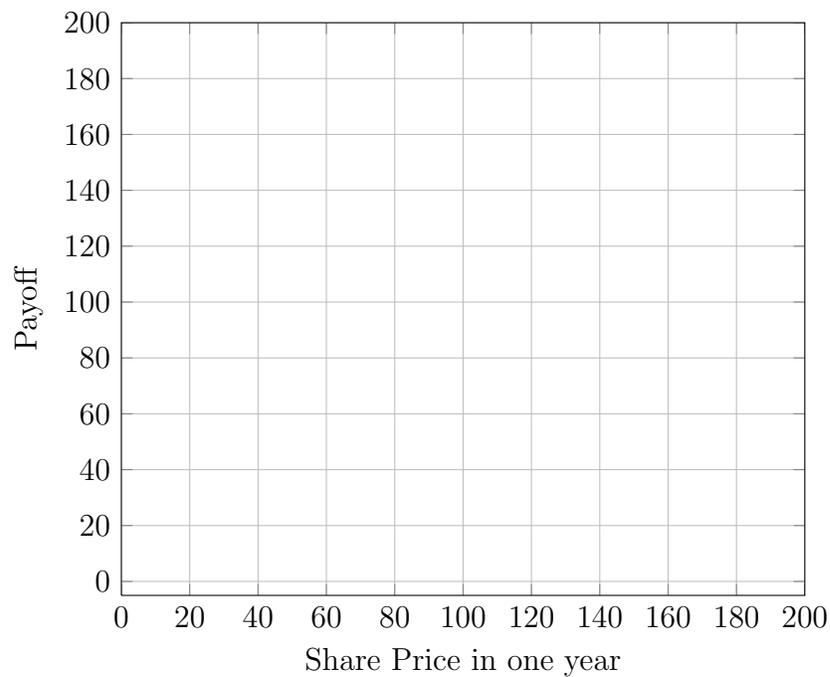
    b. (5 points) You decide to evaluate this option with a binomial tree. Below is the 1-period binomial share price tree with $h = 1$. The risk-free rate is 10% (**continuously compounded**) and the dividend yield is zero.

$100 ⟨ $160 / $60
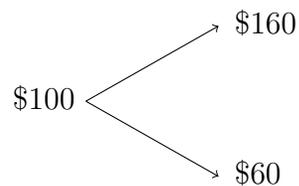
What is the payoff of the asset-or-nothing put if the share price goes up to $160? What is the payoff of the asset-or-nothing put if the share price goes down to $60?

P_1^u

P_1^d

c. (5 points) What is the risk-neutral probability of the share price going up?

Risk-neutral probability p^*

d. (5 points) What is the price of the asset-or-nothing put option? Is Donald Trump charging the right price?

Asset-or-nothing put price

e. (5 points) Consider an **asset-or-nothing call option** with the same maturity and the same strike price as the above put option. Its payoff is equal to the share price as long as the share price exceeds \$100. If the share price remains below \$100, the option expires as worthless. Draw the **payoff** diagram for the asset-or-nothing call option. What is the value of the payoff if the price of the asset in one year is \$160? Clearly indicate this value on the diagram.
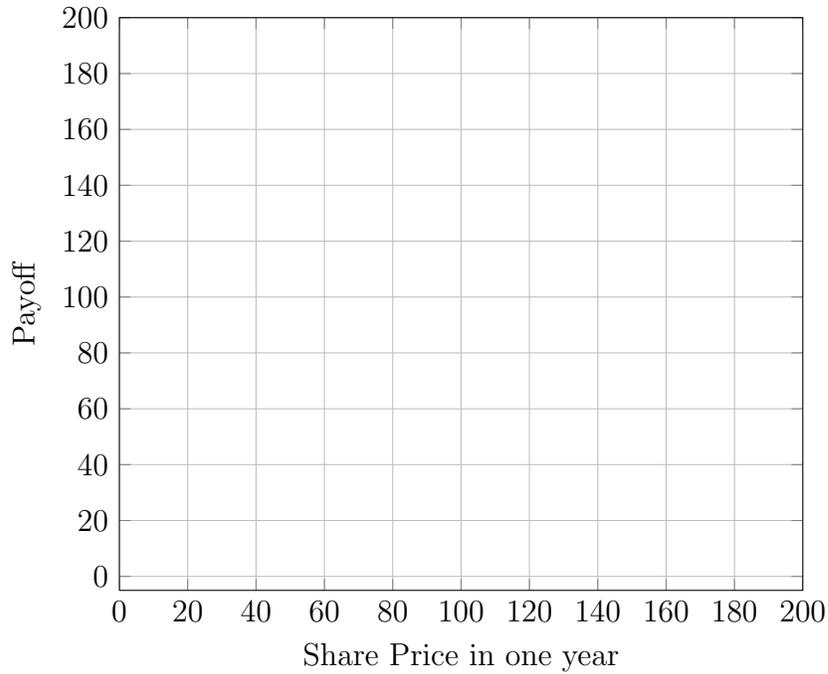
f. (5 points) Write down the put-call parity relation between these two asset-or-nothing options, at any time t between today and the maturity.

4 (15 points) Below is information (per-share) for a 102-strike **put** with one year to expiration, where $S = \$100$, $r = 0.08$, $\sigma = 0.30$, and $\delta = 0$.

	Day 0	Day 3
Stock Price	$100	$97.75
Option Price	8.8846	9.7185
Delta	-0.3629	-0.3926
Gamma	0.0125	0.0132
Vega	0.3752	0.3742
Theta	-0.0055	-0.0050
Rho	-0.4518	-0.4770
Psi	0.3629	0.3806
Elasticity	-4.0848	-3.9490

A dealer *sells* this put option, on **100 shares**. You are to describe the dealer's hedge and evaluate profit or loss after **3 days**.

a. (5 points) On day 0, how many shares does the dealer buy or sell to delta-hedge the written put? (Fractional shares are permissible.) Explain intuitively why the dealer is long or short shares.

Number of shares

b. (5 points) Taking into account the option premium received and the share transaction from part (a), what position in the risk-free asset will give the dealer zero net investment? (Be clear about whether the dealer is *borrowing* or *lending*.)

Net Investment

c. (5 points) The beta of the stock is equal to 2. What is the beta of the put option on day 0? What is the volatility of the put option on day 0?

Beta of the put option

Volatility of the put option

UCLA ANDERSON SCHOOL OF MANAGEMENT

Daniel Andrei, Option Markets 232D, Fall 2013

Solutions to Final Exam (FEMBA)

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. Theta is called time decay because it measures the change in the option price relative to a change in the time to expiration.

   b. The historical figure is calculated using past returns. Implied is an observable figure derived from actual option prices and the Black-Scholes formula.

   c. Futures are more liquid and positions are easily closed. Futures eliminate counter party credit risk. Since futures are standardized, opening a position is easier and less expensive.

   d. The increase of the dividend yield will reduce the price of the call option. Stocks which are ex-dividend tend to decline in price, thus reducing the intrinsic value of call options and the resulting option prices.

   e. The price of the forward contract is

$$F_{0,9/12} = \$950.46 \times e^{(0.084-0.014)\times 9/12} = \$1001.69$$

   f. The prices of zero-coupon bonds are

$$P(0,1) = \frac{1}{1+0.052} = \$0.9506$$
$$P(0,2) = \frac{1}{(1+0.055)^2} = \$0.8985$$
$$P(0,3) = \frac{1}{(1+0.058)^3} = \$0.8444$$

   g. The 3-year swap price for corn is

$$\bar{F} = \frac{\$0.9506 \times \$2.1 + \$0.8985 \times \$2.2 + \$0.8444 \times \$2.35}{\$0.9506 + \$0.8985 + \$0.8444} = \$2.21$$

2   a. The position with calls is as follows:

Option	Call(90)	Call(100)	Call(110)
Position	+1	-2	+1

b. The position with puts is as follows:

Option	Put(90)	Put(100)	Put(110)
Position	+1	-2	+1

c. No. Since the symmetric butterfly spread has non-negative payoff, it must have a positive value.

d. This strategy is called the symmetric butterfly spread. The benefit of the symmetric butterfly spread is that potential losses are never greater than its cost. The potential gain, however, is also limited. The largest profit is realized if the stock is at or very near the middle strike price ($100 in this case) on expiration day. The butterfly spread is thus a conservative strategy with limited potential losses and profit. It profits from stocks that are stagnant or stocks that are trading within a very tight price range.

3 a. The payoff of the asset-or-nothing put is
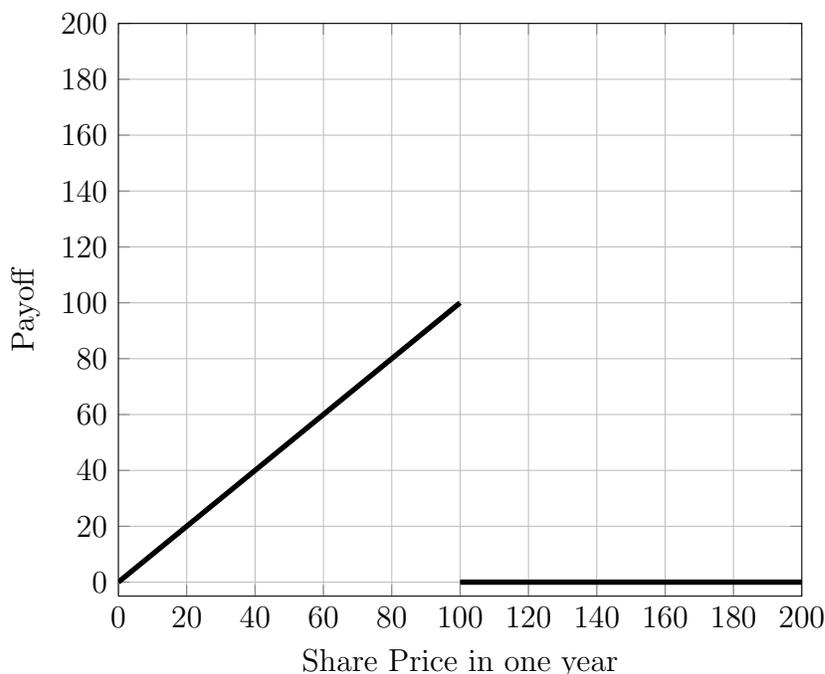
b. If the share price goes up to $160, the payoff is equal to $0. If the share price goes down to $60, the payoff is equal to $60.

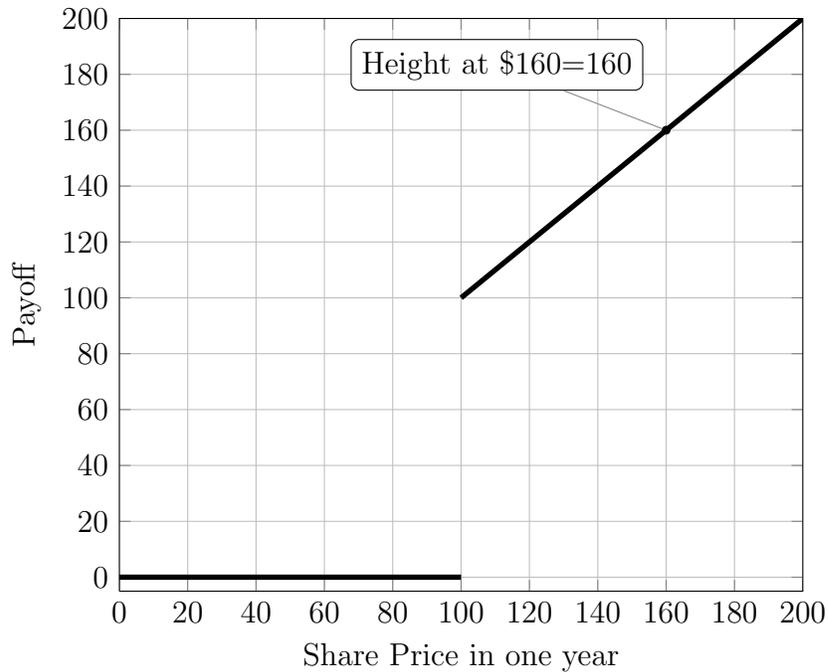c. The risk-neutral probability of the share price going up is

$$p^* = \frac{e^r - d}{u - d} = \frac{e^{0.1} - 0.6}{1.6 - 0.6} = 0.5052$$

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d. The price of the asset-or-nothing put is

$$e^{-0.1}[0.5052 \times \$0 + 0.4948 \times \$60] = \$26.86$$

Donald Trump is charging the right price.

e. The payoff of the asset-or-nothing call is

f. Holding both the asset-or-nothing put and the asset-or-nothing call is equivalent with holding the asset. Thus, the put-call parity in this case is:

$$C_t + P_t = S_t \tag{1}$$

4   a. The dealer buys -36.29 shares, which is a short position. Intuitively, the dealer is short a put, which is implicitly long shares, so the dealer shorts shares to hedge.

b. The net cash flow associated with selling the options and hedging is

$$8.8846 \times 100 - (-0.3629) \times 100 \times 100 = \$4517.46$$

Thus, the dealer *lends* $4517.46.

c. Use the elasticity of the option for both calculations. The beta of the put option is $-4.0848 \times 2 = -8.17$. The volatility of the put option is $4.0848 \times 0.3 = 122.5\%$ (volatility should always be positive, so you ignore here the negative sign of the elasticity).

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