

## Homework 6: Answer Key

### Problem 1: Multiple Choice

- 1) A put option on the stock of Harley-Davidson (HDI) has an exercise price of \$30. The current stock price is \$24.25. The put option is \_\_\_\_\_.  
A) at the money  
**B) in the money**  
C) out of the money  
D) we do not have enough information to answer this question
- 2) The maximum loss a buyer of a stock call option can suffer is the \_\_\_\_\_.  
**A) call premium**  
B) stock price  
C) stock price minus the value of the call  
D) strike price minus the stock price
- 3) A writer of a call option will want the value of the underlying asset to \_\_\_\_\_ and a buyer of a put option will want the value of the underlying asset to \_\_\_\_\_.  
**A) decrease; decrease**  
B) decrease; increase  
C) increase; decrease  
D) increase; increase
- 4) You buy one August call option with a strike price of \$50 and one August put contract of JJ with the same strike price. The call premium is \$4.25 and the put premium is \$4.50. Your strategy is useful if you believe that the stock price \_\_\_\_\_.  
A) will be lower than \$41.25 in August  
B) will be between \$41.25 and \$58.75 in August  
C) will be higher than \$58.75 in August  
**D) both A) and C) are correct**
- 5) The stock price of BK is currently \$105. The stock price a year from now will be either \$130 or \$90 with equal probabilities. The interest rate at which investors invest in riskless assets is 10% p.a. Using the binomial pricing model, the value of a call option with an exercise price of \$110 and an expiration date one year from now should be worth \_\_\_\_\_ today.  
**A) \$11.60**  
B) \$15.00  
C) \$20.00  
D) \$40.00
- 6) Buyers of put options anticipate the value of the underlying asset will \_\_\_\_\_ and sellers of call options anticipate the value of the underlying asset will \_\_\_\_\_.

- A) increase; increase
  - B) decrease; increase
  - C) increase; decrease
  - D) **decrease; decrease**
- 7) Before expiration, the time value of a call option is equal to
- A) zero.
  - B) **the actual call price minus the intrinsic value of the call.**
  - C) the intrinsic value of the call.
  - D) the actual call price plus the intrinsic value of the call.
- 8) HighFlyer Stock currently sells for \$48. A one-year call option with strike price of \$55 sells for \$9, and the risk free interest rate is 6%. What is the price of a one-year put with strike price of \$55?
- A) \$9.00
  - B) **\$12.89**
  - C) \$16.00
  - D) \$18.72
- 9) A hedge ratio of 0.70 implies that a hedged portfolio should consist of
- A) long 0.70 calls for each short stock.
  - B) short 0.70 calls for each long stock.
  - C) **long 0.70 shares for each short call.**
  - D) long 0.70 shares for each long call.
- 10) Portfolio A consists of 150 shares of stock and 300 calls on that stock. Portfolio B consists of 575 shares of stock. The call delta is 0.7. Which portfolio has a higher dollar exposure to a change in stock price?
- A) **Portfolio B**
  - B) Portfolio A
  - C) The two portfolios have the same exposure.
  - D) A if the stock price increases and B if it decreases.
- 11) Use the two-state put option value in this problem.  $S_0 = \$100$ ;  $X = \$120$ ; the two possibilities for  $S_T$  are \$150 and \$80. The range of  $P$  across the two states is \_\_\_\_; the hedge ratio is \_\_\_\_.
- A) **\$0 and \$40; -4/7**
  - B) \$0 and \$50; +4/7
  - C) \$0 and \$40; +4/7
  - D) \$0 and \$50; -4/7
- 12) You purchased an annual interest coupon bond one year ago with 6 years remaining to maturity at the time of purchase. The coupon interest rate is 10% and par value is \$1,000. At the time you purchased the bond, the yield to maturity was 8%. If you sold the bond after receiving the first interest payment and the bond's yield to maturity had changed to 7%, your annual total rate of return on holding the bond for that year would have been \_\_\_\_\_.
- A) 7.00%
  - B) 8.00%
  - C) 9.95%
  - D) **11.95%**

**Problem 2.**

*a) Explain why an American option is always worth at least as much as a European option on the same asset with the same strike price and expiration date.*

The holder of an American option has all the same rights as the holder of a European option except that she can exercise the option not only on the expiration date but also on any date prior to the expiration date. It must therefore be that an American option is worth at least as much as a European option.

*b) Is it more valuable to own an option to buy a portfolio of stocks or to own a portfolio of options to buy each of the individual stocks? Say briefly why.*

It is more valuable to own a portfolio of options to buy each of the individual stocks than to buy an option to buy a portfolio of stocks, because you can choose whether you want to exercise each option separately. You only exercise the options where the exercise prices of the stocks are below the current market values of the stocks. A portfolio of options has therefore a higher payoff than an option on a portfolio of the stocks.

*c) Discuss the differences in writing covered and naked calls. Are risks involved in the two strategies similar or different? Explain.*

Writing a covered call is writing a call on stock the investor owns. Thus, this strategy is very conservative; the investor receives the premium income from writing the call. If the call is exercised, the stock is called away from the investor; thus the investor has limited his or her upside potential.

Writing a naked call is a very risky strategy. The investor sells a call on a stock the investor does not own. If the price of the stock increases, the option will be exercised and the investor must go into the open market and buy the stock at the prevailing market price.

Theoretically, the price to which the stock can increase is unlimited; thus, the investor's potential loss is unlimited.

**Problem 3.**

*European call options on Martha Stewart Living are available with strike prices of \$15, \$17.5, and \$20 and expiration dates in 3 months. Their prices are \$4, \$2, and \$0.5, respectively.*

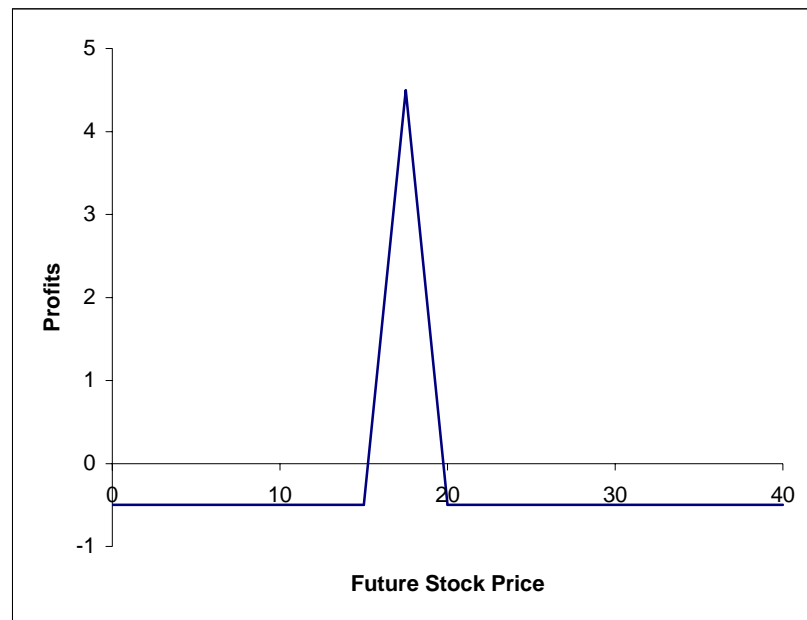
*a) Explain how the options can be used to create a butterfly spread.*

Buy a call option with a strike price of \$15, write two calls with a strike price of \$17.5, and buy a call option with a strike price of \$20.

*b) What are the net cash flows of a butterfly spread when you first buy or sell the call options and the net cash flows in the future, when the options expire. (Note that the initial payoffs are certain, but the future payoffs depend on the stock price).*

Action	Today	At Expiration			
		$S_T < 15$	$15 < S_T < 17.5$	$17.5 < S_T < 20$	$S_T > 20$
Buy one call at $X=15$	-4	0	$S_T - 15$	$S_T - 15$	$S_T - 15$
Write two calls at $X=17.5$	4	0	0	$-2S_T + 35$	$-2S_T + 35$
Buy one call at $X=20$	-0.5	0	0	0	$S_T - 20$
Net Cash Flows	-0.5	0	$S_T - 15$	$20 - S_T$	0

A butterfly spread costs today \$0.50 and pays off between \$0 and \$5 in the future depending on the stock price. It only pays off in the future if the stock price is between \$15 and \$20. The profits are shown in the following figure:



c) Based on your results, provide some intuition about who would be interested in using this strategy.

Based on the results in the table and the figure we can observe that investors would profit only if the price of the stock at maturity is close to 17.5 (strike of the short call). In particular, they would have positive profits for the range of prices between 15.5 and 19.5. You can easily convince yourself by plugging these two numbers in the table or more easily by noting the fact that profits are obtained by parallel shifting of the payoff graph down.

Who would like to hold this strategy? Probably, someone who does not believe in a large volatility of the stock price, i.e. someone who believes that the price of the stock will not move outside the above specified range.

**Problem 4.**

You observe the following prices for an American put option on K-Mart. The stock price of K-Mart is just \$0.10. A put option with a strike price of \$25 and an expiration date in one year trades at \$26. The effective annualized interest rate is 2%. Are there any profitable arbitrage opportunities? If yes, please describe the transactions and all the cash flows in detail. If no, please explain in detail why an arbitrage is not possible in this case.

The put price is above the strike price. This should not occur, because nobody should be willing to pay \$26 for this option, which pays only \$25 in the best possible case. (For the put buyer, the best possible case is when the company goes broke and the stock price is \$0.)

Arbitrage Strategy:

- Write a put option and receive \$26.
- Invest the proceeds at 2%.
- Whenever the put option gets exercised during the next year, you are obliged to buy K-Mart stock for \$25 and you will receive a stock. You will always have enough money to pay the strike price from the initial proceeds from the sale of the put option.
- If the put will not be exercised (in the unlikely event that K-Mart stock increases above \$25), then you will pocket the whole proceeds including interest.

	Today's	Future Cash Flows ( $0 < T < 1$ )	
	Cash Flow	$S_1 < 25$	$S_1 > 25$
Write put	26	$S_1 - 25$	0
Invest proceeds	-26	$26(1+0.02)^T$	$26(1+0.02)^T$
Net Cash Flows	0	$S_1 + 26(1+0.02)^T - 25 > 0$	$26(1+0.02)^T > 0$

**Problem 5.**

Starbucks is a non-dividend paying stock. Its current stock price is \$36.70. An European call option with an expiration after one year and a strike price of \$35 trades at \$5.10. A European put option with the same expiration and the same strike price trades at \$3.60. The effective annualized interest rate is 2%. Are there any profitable arbitrage opportunities? If yes, please describe the transactions and all the cash flows in detail. If no, please explain in detail why an arbitrage is not possible in this case.

Put-Call Parity is violated, because stock trades at \$36.70, but synthetic stock ( $C - P + PV(X)$ ) trades at only \$35.81. The arbitrage strategy generates a profit of \$0.89 for each unit of shorted stock.

	Today's	Cash Flows in One Year	
	Cash Flow	$S_1 < 35$	$S_1 > 35$
Short-sell stock	36.70	$-S_1$	$-S_1$
Buy call	-5.10	0	$S_1 - 35$
Write put	3.60	$S_1 - 35$	0
Invest $PV(X)$	-34.31	35	35
Net Cash Flows	0.89	0	0