

BUS 316
Assignment for Week #2

1. The chief financial officer (CFO) of the corporation you work for recently told you that he had a strong preference to use forward contracts rather than futures contracts to hedge. "You can get contracts tailor-made to suit your needs." Comment on the CFO's statement. What other factors influence the decision to use futures or forward contracts?
2. Zack Wheat has just bought four Sept. 5,000 bushel corn futures contracts at \$1.75/bushel. The initial margin requirement is 3%. The maintenance margin requirement is 80% of the initial margin requirement.
 - (a) How many dollars in initial margin must Zack deposit?
 - (b) If the price of September corn rises to \$1.85, how much equity is in Zack's commodity account?
 - (c) If the price of September corn falls to \$1.70, how much equity is in Zack's commodity account? Will Zack receive a margin call?

Assignment for Week #3

1. Define the following:
 - i) basis; ii) location basis; iii) maturity basis; iv) contango
 - v) backwardation; vi) arbitrage; vii) cash and carry arbitrage

Explain how the cost of carry affects the relationship between spot and futures prices. How do changes in the cost of carry affect the basis over the life of a futures contract?

2. Assume that the S&P 500 currently has a value of 200 (in 'index' terms). The dividend yield on the underlying stocks in the index is expected to be 4% over the next six months. New-issue Treasury bills now sell for a six-month yield of 6%.
 - (a) What is the theoretical value of a six-month futures contract on the S&P 500?
 - (b) Why would the actual futures price be expected to deviate somewhat from the theoretical value?

Assignment for Week #4

3. Suppose there is a financial asset, ABC, which is the underlying asset for a futures contract with settlement six months from now. You know the following about this financial asset and futures contract: in the cash market ABC is selling for \$80; ABC pays \$8 per year in two semi-annual payments of \$4, and the next semi-annual payment is due exactly six months from now; the current six month interest rate at which funds can be loaned or borrowed is 6%.
 - (a) What is the theoretical (or equilibrium) futures price?
 - (b) What action would you take if the futures price is \$83?
 - (c) What action would you take if the futures price is \$76?
 - (d) Suppose that ABC pays interest quarterly instead of semi-annually. If you know that you can reinvest any funds you receive three months from now at 1% for three months (4% annual), what would

be the theoretical futures price for six-month settlement be?

(e) Suppose that the borrowing and lending rate are not equal. Instead suppose that the current six-month borrowing rate is 8% (annual) and the six-month lending rate is 6%. What is the boundary for the theoretical futures price?

4. Consider a forward contract on mangoes that requires the delivery of \$1,000 kilograms of the fruit three months from now. The spot price of mangoes is currently \$4 per kilogram. It costs \$0.20 per kilogram to store mangoes for three months. If the three month risk free rate is 5% per annum, what is the (arbitrage-free) price of this futures contract?

BUS 316 **Assignment for Week #5**

1. Patricia Yamada, a trader in the foreign exchange department of the CIBC, specializes in arbitraging US dollars against Deutschmarks (DM). She observes the following rates just after the opening at 9:10 am:

Spot rate: DM 1.82 = US\$1.00

Three-month forward exchange rate: DM 1.80 = US\$1.00

Yamada can borrow or invest US dollars for three months at 9% per annum or Deutschmarks for three months at 5% per annum. She is allowed to borrow up to US\$5,000,000 or the equivalent amount in DM.

a) Ignoring transactions costs, explain precisely the transactions required for Patricia Yamada to make an arbitrage profit and calculate the precise amount of profit if the full borrowing limit is used? (Assume that she prefers to take profits in US\$ terms).

b) If the three-month US\$ interest rate increases immediately to 10% per annum, other conditions remaining the same, would she still make a profit using the strategy described in a)? What strategy would now make an arbitrage profit and how large would the profit be?

2. In early 1980, the spot and 1 year forward rates for Swiss francs (per US dollar) were \$.6968 and \$.6700 respectively. What risk-free interest rate on Swiss francs would be consistent with the interest-rate-parity theorem if the 1 year risk-free rate on US dollars was 15%?

3. Derive the profit profile for a spread trade with equal position sizes. What factors determine the profitability of this trade? Derive the profit profile for a tailed spread and explain how this trade is different from one with one-to-one position sizes. Does your answer depend on the commodity under consideration?

4. What factors determine the profitability of: a turtle trade; a butterfly; a tandem? What trading strategy is most applicable to trading the TED spread?

BUS 316
Assignment for Week #6

1. Assume you are convinced that the spread between long and short term interest rates is going to narrow within the next few months but you do not know whether rates in general will be higher or lower than they are at present. As reflected in market prices, other investors appear to disagree with your prediction: they expect the spread to remain constant. How could you profit from your superior predictive ability by using the markets for futures in financial instruments?

2. In April, a bank wants to "lock-in" today's interest rate on a \$1 million issue of 6-month negotiable CD's due to take place in three months.

b) In June a bank wants to "lock-in" today's interest rates on a \$10 million purchase of 3 month Tbills in September.

c) A bond dealer expects interest rates to rise and wants to protect itself against capital losses on its Tbond inventory.

Why will basis variation affect the performance of the hedge? Which of your answers involves a cross hedge?

3. Derive a "closed-form" expression for the risk-minimizing hedge ratio. In what sense is this ratio an optimal hedge ratio? Assuming mean-variance agents, derive an expression for the optimal speculative position size. What happens to this position as the variability of spot prices increases?

WEEK #7

MIDTERM, NO ASSIGNMENTS OR TUTORIALS

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BUS 316
SAMPLE MIDTERM EXAM QUESTIONS

1. a) Explain the arbitrage underlying the covered interest parity theorem discussed in Sec. 2.2. What assumptions are being made about both the execution of the arbitrage and the underlying securities?
 - b) Will CIP hold for all types of money market instruments? Which money market security will produce the smallest deviations from the covered interest parity conditions? Why? What institutional characteristics of Bankers' Acceptance, commercial paper and treasury bills would make it difficult for CIP transactions to be instantaneously executed in those markets? Be as complete as possible in explaining your answer.
 - c) On March 1, 1990 the spot and 3 month forward rates for the Canadian dollar (per US dollar) were \$1.1922 and \$1.2072 respectively. What "risk-free" discount rate on U.S. dollar instruments would be consistent with the interest-rate-parity theorem if the 3 month (annualized) risk-free rate on Canadian dollar instruments was 13.10%?
 - d) On Aug. 8, 1994, the spot and 5 year forward rates for the Canadian dollar/US dollar exchange rate were \$1.3797 and \$1.4917. Using interest rate information provided in Tables 2.2.3 and 2.2.5 what "arbitrage free" interest rate on 5 year zero coupon US dollar instruments would be consistent with CIP?
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2. a) Derive the profit profile for a spread trade with equal position sizes. What factors determine the profitability of this trade? Derive the profit profile for a tailed spread and explain how this trade is different from one with one-to-one position sizes. Does your answer depend on the commodity under consideration?
 - b) What factors determine the profitability of: a copper turtle trade; an oil butterfly; a NOB tandem? What trading strategy is most applicable to trading the TED spread?
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3. a) Are forward prices unbiased predictors of future spot prices?
 - b) It is often stated that futures price levels follow random walks. What is the relationship of this hypothesis with the hypothesis that forward prices are unbiased predictors of future spot prices?
 - c) If futures prices are at full carry, is this inconsistent with the hypothesis the futures prices are unbiased predictors and there are zero expected profits to speculation? If so, what type of trading strategy could be used to profit from this discrepancy?
 - d) Assume that you are convinced that the spread between the implied carry return in gold futures will narrow relative to the return implied in silver futures. How would you design a trade to profit on your predictive ability in this case?

4. a) Derive a "closed-form" expression for the risk-minimizing hedge ratio. In what sense is this ratio an optimal hedge ratio? How is your answer affected if the commodity being hedged is undetermined at the time the hedge is "put on", e.g., a wheat farmer hedging the output for a crop which has just been planted.

b) Assuming mean-variance agents, derive an expression for the optimal speculative position size. What happens to this position as the sensitivity of the agent to risk diminishes? Based on this, what can you conclude about the equilibrium in a market dominated by risk-neutral speculators?

5. a) Outline appropriate questions to be addressed by a commercial or chartered bank undertaking a financial futures hedging decision. Explain in detail the appropriate hedging strategies for the following:

i) In April, a bank wants to "lock-in" today's interest rate on a \$1 million issue of 6-month negotiable CD's due to take place in three months.

ii) A Canadian bond dealer expects US interest rates to rise and wants to protect itself against Canadian dollar capital losses on its US Tbond inventory.

iii) In June, a metals refinery wants to "lock-in" today's price on a purchase of 50,000 lbs. of copper cathodes due to take place in September.

b) What is portfolio insurance and what role do stock index futures play in insuring portfolios? What role did stock index futures play in the October 1987 market break? Identify and explain some factors that restrict the execution of stock index futures arbitrages.

BUS 316
Assignment for Week #8

1. Using the information in the attached Table of CBOE option prices, answer the following questions:
 - (a) What is the time value of a Federal Express JAN 60 call option?
 - (b) What is the intrinsic value of a BankAmerica Jan 17 1/2 call option?
 - (c) What is the intrinsic value of a BankAmerica FEB 17 1/2 put?
 - (d) Suppose you write an IBM FEB 125 call, what is your maximum possible profit?
 - (e) Suppose you buy an Upjohn APR 90 put, what is your expiration date profit if Upjohn on that date is selling for \$85 3/8?
 - (f) what is your maximum possible profit if you buy an Eastman Kodak FEB 70 call?

 - (g) Construct an expiration date profit diagram for the purchase of a Squibb APR 120 call;
 - (h) Construct an expiration date profit diagram for an uncovered written call using the APR 25 call on Halliburton;
 - (i) Construct an expiration date profit diagram for the purchase of a Bell Atlantic JAN 70 put; (j) Construct an expiration date profit diagram for an uncovered written put for Delta Airline APR 50;

 - (k) Suppose you owned 200 shares of Federal Express on Dec. 30 at which time you bought 2 APR 65 puts to protect against a declining stock price. At option expiration Federal Express stock sold for \$60. What is the expiration date payoff on the portfolio combining the stock and put?
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2. Derive the expiration-date profit diagrams for the following trades: straddle, strap, vertical spread, and horizontal time spread. Verify the replication strategies for a written put, a written call, a purchased put, a purchased call, and a long cash position.

BUS 316
Assignment for Week #9

1. A six-month put and a six-month call are traded on the same stock. The actual (not annualized) six month interest rate is 5%. The following market prices are observed:

Price of the call = \$10 Price of the put = \$10
Price of the stock = \$110 Exercise price = \$105
 - a) Why are these prices not consistent with absence-of-arbitrage?
 - b) Describe the transactions required to exploit the arbitrage opportunity and determine the amount of profit earned on the transaction (per unit of stock).

2. Suppose there are puts and calls with the same X and the same time to maturity traded on a non-dividend paying stock. You observe that the call and put options prices are equal and that the riskless interest rate for the period remaining to the expiration date of the options is 5%. Is the call option in-, at- or out-of-the-money? What about the put option? Explain.

3. Suppose there are only two possible future states of the world. In state 1 the stock price rises by 50%. In state 2, the stock price drops by 25%. The current stock price $S(0) = \$50$. If a call option has an exercise price of \$50 and the risk-free rate (r) for the period is 5%: (a) Calculate the call option hedge ratios; (b) Use the binomial option pricing model to value the call option.

BUS 316
Assignment for Week #10

1. You are currently in period 0. Consider the binomial option pricing model when the stock price is permitted to progress **two** periods into the future. The current (period 0) stock price is \$100. The stock price evolves by either rising 50% or dropping by 25% each period. The risk free interest rate for each period is 10%. Assume that a European call is written on this stock with exercise price $X = \$120$ and expiration date at the end of period 2.

a) What are all the possible values for the stock price at the end of the first period and at the end of the second period? (Hint: It would be easiest to write down the appropriate two-step binomial tree.)

b) Using the period 2 expiration date call option prices and stock prices, calculate the call option hedge ratio needed at end of the first period if the stock price increases in the first period. Calculate the call option hedge ratio needed at the end of the first period if the stock price declines in the first period. What are the call option prices applicable at the end of the first period?

c) Calculate the period 0 call option price.

Assignment for Week #11

1. Use the Black-Scholes option pricing model to value the following European call option on a non-dividend paying stock. Be sure to state the formula and provide sufficient information about the calculations performed to arrive at the solution:

Current stock price: \$30 Exercise price: \$40 Time to expiration: 3 months
Risk free interest rate: 5% per year Variance of annual stock returns: 0.25

2. Suppose $\sigma = .35$, $S(0) = \$100$, $X = \$100$, $r = .05$ and $t^* = .5$ (the option has six months to expiration). Assuming that the stock pays no dividends, calculate the Black-Scholes call and put option prices.

3. If the risk of a stock increases, what is likely to happen to the prices of call options on the stock? To the prices of put options? What happens if interest rates change? Explain.

4. Explain how the Black-Scholes model can be used to structure portfolios containing options. What is meant by the delta, theta and gamma of a position and how are these concepts used in portfolio design?

Assignment for Week #12

1. A short stock position can be "protected" by either selling a put or buying a call. Determine the profit functions for these alternative strategies and determine the breakeven stock price at expiration together with the maximum and minimum profits.

2. What is portfolio insurance and what role do stock index futures play in insuring portfolios? What role did stock index futures play in the October 1987 market break? Identify and explain some factors that restrict the execution of stock index futures arbitrages.

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Sample Final Examination Questions

BUS 316
Derivative Securities

1. a) "A call option benefits from increases in the stock price and these increases can be very large. A put option benefits from stock price declines, but the stock price can only fall to zero. Therefore, if we have a put and a call on the same stock with the same terms, the put must sell for less than the call." Do you agree or disagree? Explain making sure that you identify relevant restrictions on the underlying arbitrage.
- b) **Describe** the delta, gamma and theta for a time spread and a butterfly spread, both using puts.
- 2.a) Explain how the Black-Scholes model can be used to structure portfolios containing options. What is meant by the delta, theta and gamma of a position and how are these concepts used in portfolio design?
- b) Explain how to create a position which is delta neutral and gamma negative and contains a long stock position. Describe a specific example of how the position would be implemented.
3. a) A long stock position can be "protected" by buying a put. How can the payoff on this portfolio of a stock and option be replicated using "dynamic hedging" strategies involving portfolios which combine only stock and bond positions?
- b) Describe the various forms of portfolio insurance. How would these various forms of portfolio insurance perform in the face of discontinuous movements in equity prices such as the October 1987 market break?
- 4.a) Outline the continuous time derivation of the Black-Scholes option pricing model. What assumptions are being made to derive the results?
- b) What are the limitations of applying the model to actual options prices (being sure to identify what corrections have to be made to the Black-Scholes formula to, e.g., incorporate dividend paying stocks)?
- c) Under what conditions will American currency call options be exercised early?