



INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Mid-Autumn Semester Examination 2023-24

Date of Examination: 18/09/2023

Session: AN

Duration: 2 Hrs

Full Marks: 30

Subject No. : HS40091/HS40201

Subject : DERIVATIVES

Department/Center/School: Humanities and Social Sciences

Specific charts, graph paper, log book etc., required: None

Special Instructions (if any) : (i) Answer all the questions. (ii) Use of non-programmable calculator is permitted. (iii) While answering all the necessary steps/calculations should be clearly shown. (iv)

This question paper contains 2 printed pages.

1. You would like to speculate on a rise in the price of a certain stock. The current stock price is \$29 and a 3-month call with a strike price of \$30 costs \$2.90. You have \$5,800 to invest. Identify two alternative investment strategies, one in the stock and the other in an option on the stock. What are the potential gains and losses from each? [2]
2. "Options and futures are zero-sum games." What do you think is meant by this? Explain with the help of an example. [2]
3. Sixty futures contracts are used to hedge an exposure to the price of silver. Each futures contract is on 5,000 ounces of silver. At the time the hedge is closed out, the basis is \$0.20 per ounce. What is the effect of the basis on the hedger's financial position if (a) the trader is hedging the purchase of silver and (b) the trader is hedging the sale of silver? [2]
4. Trader A enters into futures contracts to buy 1 million euros for 1.3 million dollars in three months. Trader B enters in a forward contract to do the same thing. The exchange rate (dollars per euro) declines sharply during the first two months and then increases for the third month to close at 1.3300. Ignoring daily settlement, what is the total profit of each trader? When the impact of daily settlement is taken into account, which trader has done better? [2]
5. A trader owns a commodity that provides no income and has no storage costs as part of a long-term investment portfolio. The trader can buy the commodity for \$1,250 per ounce and sell it for \$1,249 per ounce. The trader can borrow funds at 6% per year and invest funds at 5.5% per year (both interest rates are expressed with annual compounding). For what range of 1-year forward prices does the trader have no arbitrage opportunities? Assume there is no bid-offer spread for forward prices. [2.5]
6. Suppose you are a dealer in sugar. It is September 26, and you hold 112,000 pounds of sugar worth \$0.0479 per pound. The price of a futures contract expiring in January is \$0.0550 per pound. Each contract is for 112,000 pounds. (i) Determine the original basis. Then calculate the profit from a hedge if it is held to expiration and the basis converges to zero. Show how the profit is explained by movements in the basis alone. (ii) Rework this problem, but assume the hedge is closed on December 10, when the spot price is \$0.0574 and the January futures price is \$0.0590. [2.5]
7. Construct an arbitrage example involving an asset that can be sold short, and use it to explain the cost of carry model for pricing futures. [2.5]

8. Explain carefully the meaning of the terms convenience yield and cost of carry. What is the relationship between futures price, spot price, convenience yield, and cost of carry? [2.5]

9. Consider the price of a futures contract $F(t, T)$ with delivery time T on a stock with price S_t at time t ($t < T$). Suppose the stock does not pay any dividends. Show that under the no-arbitrage condition the futures contract price is

$$F(t, T) = S_t e^{r(T-t)}$$

where r is the risk-free interest rate.

[2.5]

10. What is the minimum variance hedge ratio? How minimum variance hedge ratio is calculated. What is its significance in hedging? [3]

11. The following option prices were observed for a stock for July 6 of a particular year. Use this information in problems 8 through 13. Ignore dividends on the stock. The stock is priced at 165.13. The expirations are July 17, August 21, and October 16. The continuously compounded risk-free rates are 0.0503, 0.0535, and 0.0571, respectively. The standard deviation is 0.21. Assume that the options are European. For problems (i) through (iii) hold the position until expiration. Determine the profits at expiration for possible stock prices of 150, 155, 160, 165, 170, 175, and 180 and graph the results. Answer any other questions as indicated.

Strike	Calls			Puts		
	Jul	Aug	Oct	Jul	Aug	Oct
165	2.70	5.25	8.10	2.40	4.75	6.75
170	0.80	3.25	6.00	5.75	7.50	9.00

- Buy one August 165 call contract. Hold it until the options expire. Determine the profits and graph the results. Then identify the breakeven stock price at expiration. What is the maximum possible loss on this transaction?
- Buy one October 165 put contract. Hold it until the options expire. Determine the profits and graph the results. Identify the breakeven stock price at expiration. What are the maximum possible gain and loss on this transaction?
- Buy 100 shares of stock and write one October 170 call contract. Hold the position until expiration. Determine the profits and graph the results. Identify the breakeven stock price at expiration, the maximum profit, and the maximum loss.

[2+2+2.5]

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