IELM7018 Assignment 2

November 23, 2020

Due Date:

Please write your own solution in English to these questions on A4 size papers, scan and submit them onto HKUmoodle by 11:59 pm on December 4, 2020.

Questions (150 points in total, 10 marks for each question):

1. (10 marks) The 6-month and 1-year zero rates are both 12% per annum. For a bond that has a life of 18 months and pays a coupon of 8% per annum (with semiannual payments and one having just been made), the yield is 10.6% per annum. What is the bond's price? What is the 18-month zero rate? All rates are quoted with semiannual compounding.
2. (10 marks) A stock price is currently \$30. It is known that at the end of two months it will be either \$27 or \$34. The risk-free interest rate is 12% per annum with continuous compounding. Suppose S_T is the stock price at the end of two months. What is the value of a derivative that pays off S_T^2 at this time?
3. (10 marks) Draw a diagram showing the variation of an investor's profit and loss with the terminal stock price for a portfolio consisting of
   (a) One share and a short position in one call option
   (b) Three shares and a short position in two call options
   (c) Two shares and a short position in three call options
   (d) Two shares and a short position in four call options

   In each case, assume that the call option has an exercise price equal to the current stock price.
4. (10 marks) A stock price is currently \$50. It is known that at the end of one month it will be either \$52.5 or \$47.5. The risk-free interest rate is 9% per annum with continuous compounding. Use the no-arbitrage approach to find the value of a one-month European call option with a strike price of \$49?
5. (10 marks) A stock price is currently \$60. It is known that over each of the next two three-month periods it will go up by 10% or down 8%. The risk-free interest rate is 11% per annum with continuous compounding. Use the risk-neutral approach to find the value of a six-month European put option with a strike price of \$60?
6. (10 marks) A bank loan department is trying to determine the correct rate for a 2-yr loan to be made two years from now. If current zero rates are 1-yr = 2%, 2-yr = 3%, 3-yr = 3.5%, 4-yr = 4.5%, the foward rate for the loan should be?
7. (10 marks) Suppose that the risk-free interest rate is 9% per annum with continuous compounding and that the dividend yield on a stock index is 3% per annum. The index is standing at 500, and the futures price for a contract deliverable in four months is 520. What arbitrage opportunities does this create?
8. (10 marks) The 6-month, 12-month, 18-month, and 24-month zero rates are 5%, 5.5%, 5.75%, and 6%, with semiannual compounding. (a) What are the rates with continuous compounding? (b) What is the forward rate for the 6-month period beginning in 18 months? (c) What is the value of an FRA that promises to pay you 6.5% (compounded semiannually) on a principal of \$1 million for the 6-month period starting in 18 months?
9. (10 marks) A futures contract is used for hedging. Explain why the daily settlement of the contract can give rise to cash flow problems.
10. (10 marks) An investment bank can borrow or lend at LIBOR. Suppose that the 6-month rate is 5% and the 12-month rate is 8%. The rate that can be locked in for the period between 6 months and 12 months using an FRA is 7%. What arbitrage opportunities are open to the bank? All rates are continuously compounded.

11. (10 marks) Trader A enters into a forward contract to buy gold for \$1000 an ounce in one year. Trader B buys a call option to buy gold for \$1000 an ounce in one year. The cost of the option is \$100 an ounce. What is the difference between the positions of the traders? Show the profit per ounce as a function of the price of gold in one year for the two traders and plot the function.
12. (10 marks) Show that, if the futures price of a commodity is greater than the spot price during the delivery period, then there is an arbitrage opportunity. Does an arbitrage opportunity exist if the futures price is less than the spot price? Explain your answer.
13. (10 marks) A company enters into a short futures contract to sell 5,000 bushels of wheat for 450 cents per bushel. The initial margin is $\$3,000$ and the maintenance margin is $\$2,000$. What price change would lead to a margin call? Under what circumstances could $\$1,500$ be withdrawn from the margin account?
14. (10 marks) What position is equivalent to a long forward contract to buy an asset at K on a certain date and a put option to sell it for K on that date.
15. (10 marks) The following table gives data on monthly changes in the spot price and the futures price for a certain commodity. Use the data to calculate a minimum variance hedge ratio.

Spot Price Change	+0.50	+0.61	−0.22	−0.35	+0.79
Futures Price Change	+0.56	+0.63	−0.12	−0.44	+0.60
Spot Price Change	+0.04	+0.15	+0.70	−0.51	−0.41
Futures Price Change	−0.06	+0.01	+0.80	−0.56	−0.46