Problem Set 1[1]

Yan Ji

Question 1: Basic Concepts (1/10)

(1) Define what a zero-coupon bond is. (1 sentence)

(2) Define what it means to "short-sell a stock". (at most 2 sentences)

(3) Describe four major differences between exchanges and over-the-counter (OTC) markets for derivatives.

(4) Suppose a risk-free bond which pays \$100 in three years is trading at \$90 now. Compute its annual interest rate in both the "simple interest rate" convention and the "continuously-compounded interest rate" convention.

Question 2: Forwards on Stocks without Dividends (1/10) If a share in XYZ currently trades for \$100 and the risk free interest rate is 5% (annual, continuously compounded), what is the 6-month forward price?

Question 3: Forwards on Stocks with Dividends (2/10) Intel stock is trading at \$100 per share. The risk-free interest rate (annualized, continuously compounded) is 5.00%. The market assumes that Intel will not pay any dividend within the next 3 months.

(1) What must be the forward price to purchase one share of Intel stock in 3 months?

(2) Suppose that Intel suddenly announces a dividend of \$1 per share in exactly 2 months, and assume that the Intel stock price does not change upon the announcement. What must be the new 3-month forward price for the Intel stock?

(3) If after the dividend announcement, the 3-month forward price still stays the same, how would you make arbitrage profit from the market mis-pricing?

(4) Suppose that Intel suddenly announces two dividend payments of \$1 per share in exactly 1 month and 2 months, and assume that the Intel stock price does not change upon the announcement. What must be the new 3-month forward price for the Intel stock?

[1]Note: optional questions are for your practice only. They are not counted toward your grades.

Question 4: Arbitrage Opportunities in Forward Markets (2/10) Suppose the S&P 500 index spot price is 1100, the risk-free rate is 5% (annual, continuously compounded), and the dividend yield on the index is 0.

(1) Suppose you observe a 6-month forward price of 1135. What arbitrage would you undertake?

(2) Suppose you observe a 6-month forward price of 1115. What arbitrage would you undertake?

Question 5: S&P 500 Futures Contracts (2/10) Suppose the S&P 500 index is currently 950 and the initial margin is 10%. You wish to enter into a long position for 10 S&P 500 futures contracts.

(1) What is the contract size for S&P 500 Futures?

(2) What is the notional value of your position?

(3) What is the initial margin in dollars?

(4) Suppose you earn a continuously-compounded interest rate of 6% on your margin balance, your position is marked to market weekly, and the maintenance margin is 80% of the initial margin. For simplicity, we assume that today's futures price is the same as the spot price, 950. What is the greatest S&P 500 index futures price 1 week from today at which will you receive a margin call?

Question 6: The Value of A Forward Contract (2/10) This question asks you to think about how the value of a forward contract on a non-dividend paying stock changes over time.

(1) On February 20 you enter into forward contract to buy ABC shares on December 20. ABC shares currently trade at \$100. What is the forward price? (The continuously compounded interest rate is 10% and assumed to be constant for the whole calendar year.)

(2) On May 20, the price of one ABC share is \$150. What is the forward price of a forward contract with delivery date December 20 (this is a different contract)?

(3) Forward contracts are not traded on an exchange, they do not have a market price. However, a reasonable way to define the value of a forward contract is as the amount of money someone would have to pay you today to give up your forward contract. Using this definition, what is the value of the original forward contract (that you entered into in February) on May 20?

(4) Sometimes it is the case that you would be prepared to actually pay someone else for the right to walk away from a forward contract. In this case, the value of the forward contract is negative. Re-do part (iii) under the assumption that on May 20, the price of one ABC share is \$50.

(5) (Optional) What is the May 20 value of a short position in the original forward contract if the ABC share price on May 20 is \$150?

(6) (Optional) What is the May 20 value of a short position in the original forward contract if the ABC share price on May 20 is \$50?

(7) (Optional) What is the value of a long position in the original forward contract on February 20 (the entry date)?