

Midterm Exam

Monday, Apr 6, 2020

1 (20 points) Short Questions

(Please briefly explain your answers.)

- (i) (5 points) The 1 year forward on a stock trades at \$102, while the spot price of the stock is \$100. The continuously compounded annual interest rate is 4%. What is the annual dividend yield consistent with these prices? You need to show clearly how to calculate the dividend yield.
- (ii) (5 points) True or False? In a foreign exchange forward contract, the value of the forward contract is always non-negative. Write down the formula for the value of a foreign exchange forward contract and explain clearly how you get the answer.
- (iii) (5 points) Suppose you expect to receive \$100 in one year and want to use FRA to hedge the interest rate risk between year 1 and year 2. Should you take a long position or short position? Why?
- (iv) (5 points) Consider an at-the-money European call option and an at-the-money European put option on the same non-dividend-paying stock. Which one should have a higher market value? Explain clearly why this is the case.

2 (20 points) Forwards

A stock trades at $S_0 = \$50$. It pays a continuous annualized dividend rate of 2%. The continuously compounded risk-free rate is 5% per year. The 1-year forward price on this stock is \$52.

- (i) (6 points) What should be the no-arbitrage price of 1-year forward? Is the market currently over or under pricing the forward?
- (ii) (14 points) Lay out your arbitrage strategy and the cash flows at all relevant times. Make it clear what you are long/short and the quantities. What is your arbitrage profits?

3 (30 points) Futures

The current stock price of IBM is $S_0 = 100$ per share. The futures price of IBM futures that mature 2 days from today is $F_{0,2} = 100.05$. Suppose IBM does not pay any dividend. The risk-free rate is constant.

- (i) (10 points) What is the annual continuously-compounded risk-free rate implied by the futures price $F_{0,2}$?
- (ii) (12 points) Suppose the futures prices at $t = 1$ and $t = 2$ are $F_{1,2} = 99$ and $F_{2,2} = 102$, respectively. What are the implied stock prices S_1 and S_2 at $t = 1$ and $t = 2$? Calculate the profits and losses on day 1 and day 2 for buying (long position) one futures contract.
- (iii) (8 points) An investor Bob holds \$1,000,500 IBM stock at $t = 0$. Bob wants to hedge his stock position for two days using the above futures contract. What position should Bob take (short or long)? How many futures contracts should Bob long/short? Show clearly why this is a perfect hedge.

For this question, let us ignore the interest earnings on your margin account so that you do not need to change your futures position over time.

4 (30 points) Swaps

The 1, 2, 3 year oil forward trade at $F_{0,1} = \$115$; $F_{0,2} = \$110$; $F_{0,3} = \$105$ per barrel. The 1, 2, 3 year zero-coupon bonds trade at (face value \$1000) $P_{0,1} = 980.39$; $P_{0,2} = 951.84$; $P_{0,3} = 915.23$.

- (i) (5 points) Calculate the 1-year, 2-year, and 3-year annual continuously-compounded risk-free rates implied by zero-coupon bonds?
- (ii) (10 points) Calculate the swap curve, i.e., the swap prices for all three maturities.
- (iii) (15 points) Oily Lilies Inc. enters a 2-year swap to buy 100K barrels of oil at the end of years 1 and 2. The next day, the oil forward prices are: $F_{0,1} = \$110$; $F_{0,2} = \$112$. Interest rates have not changed. Ignore the one-day maturity effect. Tell Oily Lilies how much it would cost (or yield) now to “get out” of the swap. What is this amount called? Give the answer as a present value and clearly write down your derivation.