MFE5130 – Financial Derivatives
First Term, 2018-19
Midterm Examination

Exam Duration: 2 hours

Instruction

1. Total Marks: 100 points.

2. Answer **ALL** questions.

3. You must show all the steps in order to get full mark for each question.

1. Suppose that 1-year, 2-year and 3-year oil forward prices are $74.5 per barrel, $78.9 per barrel, and $81.5 per barrel respectively. The annualized continuously compounded yield of the zero-coupon bonds for different maturities are given as follows:

Maturity (in year)	Annualized continuously compounded yield
1	4.5%
2	6%
3	7.3%

Consider a 3-year oil swap with the notional amount of 1 barrel of oil. Suppose a dealer is paying the floating price and receiving the fixed swap price in the swap contract.

a. (5 points) With level payments at the end of each year, find the fixed swap price per barrel of oil in the 3-year oil swap at the inception of the swap contract.

b. (10 points) What position in oil forward contracts will hedge oil price risk in the dealer's position? What is the present value of the locked-in net cash inflows of the dealer at the inception of the swap contract?

c. (10 points) Just immediately after the inception of the swap contract the 1-year, 2-year and 3-year oil forward prices change to $75.8 per barrel, $79.9 per barrel, and $80.2 per barrel respectively and assume that all the annualized continuously compounded yields remain unchanged, what is the market value of the swap from the dealer's perspective?

2. (20 points) A financial institution sells a 2-year financial product with returns linked to Stock X, the time t value of one unit of Stock X is denoted by $S(t)$. At the maturity date, the payoff of the financial product is given by:

$$P(1 - y\%) \times \max\left[\frac{S(2)}{S(0)}, 1.04^2\right].$$

You are given the following information:

(i)   Stock X does not pay dividends.
(ii) $S(0) = 50$.
(iii) The price of a 2-year European call option on Stock X with strike price of $54.08 is $10.16.
(iv) The continuously compounded risk-free interest rate is 6%.

Determine $y\%$, so that the price of this financial product at time 0 is P.

3. (20 points) Stock A has a current price of $70 and does not pay dividends.
   Stock B has a current price of $67 and pays continuous dividends with the dividend yield of 5.3%.
   A European put option gives its owner the right to give up a share of Stock B in exchange for a share of Stock A at the end of 1 year. The premium of this option is $11.49.
   Calculate the premium of a European put option that gives its owner the right to give up a share of Stock A in exchange for a share of Stock B at the end of 1 year.

4. (20 points) Two European call options expire in 1 year. The call options have the same underlying asset, but they have different strike prices and premiums.

Call Option	A	B
Strike	50	55
Premium	14	9.25

   The continuously compounded risk-free interest rate is 7%.
   A profit-maximizing arbitrageur constructs an arbitrage strategy. Arbitrage profits are accumulated at the risk-free interest rate.
   If the stock price is $52 at the end of 1 year, then the accumulated arbitrage profits are X.
   If the stock price is $60 at the end of 1 year, then the accumulated arbitrage profits are Y.
   Find X and Y.

5. (15 points) Suppose that the current gold spot price is $350 per troy ounce and the continuously compounded risk-free interest rate is 9%. Suppose that gold can be loaned. The leased rate of the gold is 5.5%. You observe that 9-month gold forward price is $353.22 per troy ounce.
   Is there an arbitrage opportunity on the forward contract? If so, describe the strategy to realize the profit and find the accumulated arbitrage profits at the end of 9 months.

End