**MFE5130 – Financial Derivatives**

**First Term, 2016-17**

**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.
4. Suppose the S&P index is 1,200 initially and an investor invests $11,000. If the index is below 1,200 after 3 years, the CD returns to the investor the original $11,000 investment. If the index is above 1,200 after 3 years, the investor receives $11,000 plus 80% of the percentage gain on the index. However, the percentage gain on the index is capped at 105% in the CD. The continuously compounded risk-free interest rate is 5%.
5. (10 points) The final payoff of this equity linked CD can be written as



where *S*3 is the value of the S&P index at the end of year 3.

Find the values of *K*1 and *K*2.

1. (3 points) What option spread is embedded in this equity linked CD?
2. (7 points) What is the fair price of the option spread obtained in (b)?
3. (20 points) Two European put options expire in 1 year. The put options have the same underlying asset, but they have different strike prices and premiums.

|  |  |  |
| --- | --- | --- |
| Put Option | A | B |
| Strike | 50.00 | 55.00 |
| Premium | 4.00 | 8.75 |

The continuously compounded risk-free rate of return is 9%.

A profit-maximizing arbitrageur constructs an arbitrage strategy.

Arbitrage profits are accumulated at the risk-free rate of return.

If the stock price is $48 at the end of the year, then the accumulated arbitrage profits are $*X*.

If the stock price is $52 at the end of the year, then the accumulated arbitrage profits are $*Y*.

Calculate 

1. Suppose that a transportation company must buy 1,000 barrels of oil every six months, for 3 years, starting 6 months from now. Instead of buying six separate long forward contracts, the company enters into a long swap contract. The notional amount of the swap contract is 1,000 barrels. The payment of the swap will be made at the delivery times. The current forward prices of oil are

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Forward Price  ($ per barrel) | 55 | 57 | 58 | 60 | 62 | 64 |
| Expiration  (in months) | 6 | 12 | 18 | 24 | 30 | 36 |

Zero-coupon risk-free bonds are available with the following maturities and annualized continuously compounded yield:

|  |  |
| --- | --- |
| Maturity (in months) | Annualized continuously compounded yield (%) |
| 6 | 5.35 |
| 12 | 5.52 |
| 18 | 5.57 |
| 24 | 5.62 |
| 30 | 5.67 |
| 36 | 5.75 |

1. (10 points) With level payments, find the fixed swap price per barrel of oil in the swap.
2. (5 points) Suppose the swap is settled in cash. Assume that the spot rate for oil in 18 months is $57 per barrel. Calculate the net cash flow of the transportation company in 18 months. Please indicate clearly that this net cash flow is the cash inflow or outflow of the transportation company.
3. (10 points) Suppose that immediately after the swap is signed up, the forward prices of oil are given by the table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Forward Price  ($ per barrel) | 55 | 58 | 59 | 61 | 62 | 63 |
| Expiration  (in months) | 6 | 12 | 18 | 24 | 30 | 36 |

Assume that there is no change for the yield of the zero-coupon bonds. Find the market value of the swap in the perspective of the transportation company.

1. (15 points) Suppose the current stock price is $60.25 and the continuously compounded risk-free interest rate is 4%. The stock pays dividend of $3.20 in six months. You observe a 9-month forward contract with forward price $52.13. Is there an arbitrage opportunity on the forward contract? If so, describe the strategy to realize profit and find the accumulated arbitrage profits at the end of 9 months.
2. (20 points) Consider 4 sets of options. All of the options are European options on the same stock, and all of the options expire in 2 years.

Set 1 contains a long call option with a strike price of $48 and a short put option with a strike price of $54. The current value of Set 1 is $11.91.

Set 2 contains a long put option with a strike price of $48 and a short call option with a strike price of $54. The current value of Set 2 is −$10.53.

Set 3 contains a long call option with a strike price of $55 and a short put option with a strike price of $47. The current value of Set 3 is $10.30.

Set 4 contains a long put option with a strike price of $55 and a short call option with a strike price of $47.

Determine the current value of Set 4.

*End*

**Scratch Paper**