MFE5130 – Financial Derivatives
First Term, 2019-20
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. (15 points) You are given
   (i) $C(K, T)$ denotes the current price of a K-strike T-year European call option on a non-dividend-paying stock.
   (ii) $P(K, T)$ denotes the current price of a K-strike T-year European put option on the same stock as in (i).
   (iii) S denotes the current price of the stock.
   (iv) The continuously compounded risk-free interest rate is r.

   Please arrange (I), (II) and (III) below in their ascending order

   $$\text{(I). } C(60,T)+80e^{-rT}, \quad \text{(II). } P(75,T)+S, \quad \text{(III). } C(80,T)+70e^{-rT}.$$

   Give a detailed proof to your answer otherwise **0 mark** will be given.

2. (20 points) Consider a European type financial claim with 3 years to expiration. The payoff of the claim depends on the prices of Stock 1 and Stock 2 and the payoff is given by

   $$\max\left[S_1(3), S_2(3), 25\right],$$

   where $S_j(t)$ is price of one share of Stock j, $j = 1, 2$, at time t.

   The current price of this claim is \$25.50. The continuously compounded risk-free rate of return is 8%.

   Determine the current price of a three-year European option with the payoff of

   $$\max\left[\max\left(S_1(3), S_2(3)\right) - 25, 0\right].$$

3. (20 points) The current exchange rate is 0.7 euros per Canadian dollar.

   A European euro-denominated call on one Canadian dollar has a strike price of 0.625 euros and a premium of 0.08 euros. The call expires in 6 months.

   The continuously compounded interest rate available on euros is 8%. The continuously compounded interest rate available on Canadian dollars is 7%.

   Calculate the current price of a European Canadian dollar-denominated call on one euro that has a strike price of 1.6 Canadian dollars and expires in 6 months.

4. (20 points) Three 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	C
Strike	\$50	\$55	\$60
Premium	\$18	\$14	\$9.5

The continuously compounded risk-free interest rate is 8%.

A profit-maximizing arbitrageur constructs an arbitrage strategy.

Arbitrage profits are accumulated at the risk-free interest rate.

If the stock price is \$53 at the end of 1 year, then the arbitrage profits at the end of 1 year are \$$X$.

If the stock price is \$58 at the end of 1 year, then the arbitrage profits at the end of 1 year are \$$Y$.

Determine X and Y.

5. The current spot price of soybean is \$5.2 per bushel. The convenience yield and storage cost of soybean are assumed to be a constant. The convenience yield and continuously compounded storage cost of soybean are equal to 5.1% and 2.3% respectively.

You are also given that:

Years to Maturity (t) (years)	1	2	3
One-Year Implied Forward rate ($r_0(t-1, t)$)	5.31%	6.81%	8.13%

a. (15 points) Copy and complete the following table:

T (in Years)	1	2	3
$F_{0,T}$			

where $F_{0,T}$ is the T-year soybean forward price at time 0.

b. (10 points) Consider a 3-year swap contract for soybean, the notional amount of the contract is 5,000 bushels. With level payments at the end of each year, find the fixed swap price per bushel of soybean in the swap.

End