



**RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES**

**B. Sc. (Four Year) Degree in Industrial Mathematics
Fourth Year - Semester I Examination – September/October 2019**

MAT 4302 – FINANCIAL MATHEMATICS

Time allowed: Three (03) hours

Answer All (05) questions

Non programmable Calculators and Statistical table are allowed

1. a) Define Forward contract and Futures contract.
- b) What are the differences between them?
- c) A 1-year long forward contract on a non-dividend paying stock is entered into when the stock price is \$40 and the risk-free rate of interest is 10% per annum with continuous compounding.
 - i. What are the forward price and the initial value of the forward contract?
 - ii. Six months later, the price of the stock is \$45 and the risk-free interest rate is still 10%. What are the forward price and the value of the forward contract?
- d) The 2-month interest rates in Switzerland and the United States are, respectively, 3% and 8% per annum with continuous compounding. The spot price of the Swiss franc is \$0.6500. The futures price for a contract deliverable in 2 months is \$0.6600. What arbitrage opportunities does this create?

(100 marks)

2. a) Define call option and put option.
- b) Write down the payoff function of above two options in the usual notations.
- c) Draw the payoff functions in Part (b).
- d) An investor buys a European put on a share for \$3. The stock price is \$42 and the strike price is \$40. Under what circumstances does the investor make a profit? Under what circumstances will the option be exercised? Draw a diagram showing the variation of the investor's profit with the stock price at the maturity of the option.

(100 marks)

3. a) List the six factors that affect stock option prices.
- b) What is a lower bound for the price of a 4-month European call option on a non-dividend-paying stock when the stock price is \$28, the strike price is \$25, and the risk-free interest rate is 8% per annum?
- c) Suppose that c_1, c_2 and c_3 are the prices of European call options with strike prices K_1, K_2 and K_3 , respectively, where $K_1 > K_2 > K_3$, and $K_3 - K_2 = K_2 - K_1$. All options have the same maturity. Show that $c_2 \leq 0.5 (c_1 + c_3)$.

(Hint: Consider a portfolio that is long one option with strike price K_1 , long one option with strike price K_2 , and short two options with strike price K_2)

(100 marks)

4. a) Explain two ways in which a bear spread can be created.
- b) When it is appropriate for an investor to purchase a butterfly spread?
- c) What is the difference between a strangle and a straddle?
- d) Construct a table showing the payoff from a bull spread when puts with strike prices K_1 and K_2 with $K_2 > K_1$, are used.
- e) Draw the payoff diagram for part (d).
- f) An investor believes that there will be a big jump in a stock price but is uncertain as to the direction. Identify two different strategies the investor can follow and explain the differences between them.

(100 marks)

5. a) What is meant by the "delta" of a stock option?
- b) A stock price is currently \$50. Over each of the next two 3-month periods it is expected to go up by 6% or down by 5%. The risk-free interest rate is 5% per annum with continuous compounding. What is the value of a 6-month European call option with a strike price of \$51?
- c) What does the Black Scholes stock option pricing model assume about the probability distribution of the stock price in one year?
- d) What does the Black Scholes stock option pricing model assume about the continuously compounded rate of return on the stock during the year?
- e) What is the price of a European call option on a non-dividend-paying stock when the stock price is \$52, the strike price is \$50, the risk-free interest rate is 12% per annum, the volatility is 30% per annum, and the time to maturity is 6 months?

(100 marks)

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