UGANDA MARTYRS UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

FINAL EXAMS FOR BSc. FINANCIAL MATHEMATICS YEAR 3

SEMESTER I, 2022/2023

MTF 3102: FINANCIAL MATHEMATICS

DATE: THURSDAY 15TH , DECEMBER, 2022

TIME: 9:30 am – 12:30 pm

Instructions

1. Attempt ANY FOUR questions
2. Ensure that your name and registration number is indicated on the cover page of your work.
3. Where applicable, leave your answer in fractional form or round it to 2dp
4. Only Non-Programmable calculators are allowed

Question 1

(a) Differentiate between the following terms:-

(i) A call option and a put option

(ii) American option and A European option

(iii) Put – Call parity and hedge ratio

(b) Given the following information:-

Original price of stock = $100

Strike price (K) = $90

Barrier call option on stock has a payoff = $\max(S_T - K).\ I.\ (S_T < K)$ where:

I = 1 if $(S_T < B)$ or 0 otherwise

Barrier (B) = $100

If the stock is expected to move up or down by 10% and time to maturity is six months:-

(i) Draw the payoff of the option up to maturity

(ii) Determine the value of the risk neutral probability for the upward movement of stock

(iii) Determine the value of the risk neutral probability for the downward movement of stock

(iv) Determine the price of the call option at t = 0

(c) Given the following information:-

Current price of the underlying asset = $100

Strike price = $105

Time step 0.25

RFR = 3.5%

The price is expected to either go up with 20% or go down with 10% within a single time step. Determine the:-

(i) Upward factor

(ii) Downward factor

(iii) Risk neutral probability for the upward factor

(iv) Risk neutral probability for the downward factor

(v) Set up a two time step binomial model for stock and put option prices

(vi) Determine the current value of the put option

Question 2

(a) State 5 assumptions of Black Scholes Option Pricing Model

(b) Explain what is meant by the following terms in financial markets

(i) Long a call

(ii) Long a put

(iii) Short a call

(iv) Short a put

(v) ITM

(vi) OTM

(vii) ATM

(c) A company has earnings of $20 billion and has 4 billion shares outstanding. If its stock price is currently $240, determine its profit to earnings ratio

Given the following information

Assumptions		
Risk-free rate (df)		10%
Spot price (S)		100.00
up factor (u)		1.20
down factor (d)		0.90
Strike price (X)		110.00
Call or Put option? (c/p)		p
	formula toggle	(1.00)

Determine the hedge ratio

Question 3

(a) State five factors that option pricing will depend on

(b) Netflix is currently trading for $273. 40. Today is November 26th and the following options are available:-

December 280 call → $11.30

December 280 put → $17.60

Given that volatility is at 32% and the RFR is 4%, determine using the Black Scholes Option pricing model whether the option prices are fair.

(c) Differentiate between Black Scholes and Cox – Ross Rubinstein Option Pricing Model models

(d) The current stock price $40 and is expected to go up or down by 20%. If the four months put option on stock is $38. Determine the current price of the put option using Cox – Ross Rubenstein model.

Question 4

(a) Differentiate between the following:-

(i) Capital market line and security market line

(ii) Stock market and share market

(iii) Market rally and market decline

(b) Security market efficiency is very important to have a healthy financial system. Discuss

(c) Consider the following information about some trading in a security market

Parameter	Value
Expected rate of return on some market	24%
Rate of return on a risk free asset	7%.
Standard deviation of the market	32%
Standard deviation of the portfolio	20%

(i) Determine the expected return of the portfolio

(iii) If the expected return of 39% is desired, what is the standard deviation of this position

(d) Determine the expected rate of return if the market return is 7%, stock beta is 1.5 and the 10-year treasury bills are trading at 4% per annum.

Question 5

a) Suppose that the prices of security A and security B are \$30 and \$40 respectively. If one prepares a portfolio worth V(0) = \$1,000 by purchasing shares of security A and B given that their respective shares are 20 and 10. What will be the allocation of funds between the two securities?

b) Suppose the price of security A and security B above changed to \$35 and \$39 in the next period. Determine the new allocation of funds

c) If short selling is allowed, what would happen?

d) A risk free asset has a rate of 8% and the expected rate of return of some market portfolio is 12% with a standard deviation of 15%. If the standard deviation of the market is 13%, calculate the expected rate of return of the asset.

e) Consider an oil drilling venture where a share is valued at UGX875 and the expected yield is UGX1,000 after one year. Due to high uncertainty about the drilling project at the drilling site, the variance of the return is 16%. The expected rate of return of the oil venture is 17% and its variance is 1.44%. Determine:

   (i) The actual rate of return

   (ii) The expected rate of return as predicted by the Capital Market Line