

UNIVERSITY OF COLOMBO, SRI LANKA
FACULTY OF MANAGEMENT AND FINANCE

Bachelor of Business Administration (Semester V) Examination - July 2022

FIN 3230 – Financial Mathematics

Instructions:

- Time allowed is Two (02) hours.
 - This paper comprises **five (05)** questions printed on **six (06)** pages.
 - Answer **any four (04)** questions.
 - The use of scientific calculators is permitted.
 - Write answers legibly with clear handwriting.
 - This is an online and open book examination.
-

01.

- i. Ms. Waruni wants to accumulate Rs. 250,000 by the end of 8 years. She got to know about an investment plan available in a finance company that she is able to accomplish her requirement and it requires her to make equal quarterly deposits over 8 years. The plan pays interest at 12.70% per annum compounded semi-annually.
- a. Find the size of the quarterly deposit needed for Ms. Waruni to achieve her target.
 - b. Just after making deposits over 4 years, the bank changes the interest rate to $j_4 = 12\%$. Find the size of the new quarterly deposit required starting from year 5 for her to meet the target of accumulating Rs. 250,000 in 8 years.
 - c. What is the total interest earned on the fund over 8 years, regardless of the interest rate change?

(08 Marks)

- ii. Mr. Amarasingha, a retired bank manager, saw an advertisement about an investment plan introduced by a popular finance company. When he inquired details of the plan, he realized that the interest rate and the interest compounding frequency changes during the investment horizon. According to the plan it promised $j_4 = 12.39\%$ in the first 3 years, $j_2 = 10.54\%$ in next 2 years and $j_{365} = 15\%$ in the last 3 years. What is the effective rate of interest earned by Mr. Amarasingha if he invested a certain sum of money today, in this plan?

(04 Marks)

- iii. A fund of Rs. 1,000,000 was deposited to an account on 1st December 2021 that pays 8% interest compounded daily, to start a scholarship. It was expected to award semiannual scholarships for 20 years from the established fund for eligible university students. What is the size of the scholarship if the first is awarded on, 1st December 2023?

(05 Marks)

- iv. Mr. Siril is to buy a house for her daughter. A real estate company offers a newly built house for a price of Rs. 16,000,000. They gave her following options in purchasing the house.

Option 1:

If she pays in cash today, she will get a cash discount of Rs. 1,000,000.

Option 2:

If she goes on installments plan, she has to pay 25% of the full value today. She has to pay the remaining amount in 2 equal installments at the end of year 2 and year 4, with zero interest. In the first, second, third and fourth years the money can be invested at $j_1 = 18.5\%$, 19%, 20%, 20.50% respectively.

What option do you think Mr. Siril should accept from the above two options? Prove your answer with supportive calculations.

(08 Marks)

(Total 25 Marks)

02.

- i. Derive

$$P = C + (Fr - Ci) \left(\frac{1 - (1 + i)^{-n}}{i} \right)$$

When the purchase price of a bond equals the present value of coupons and the redemption value of the bond.

(04 Marks)

- ii. Rohan is interested in investing in bonds and his desired yield is $j_2 = 8\%$. But he doesn't have sound finance related knowledge. He bought Rs. 1,000 bond redeemable at par on 1st December 2024, pays semiannual coupons at $j_2 = 9\%$. The bond is bought on 1st June 2022. Rohan wanted to know the cashflow behavior relevant to the bond over the time. Imagine you are the investment advisor of Rohan and Construct the bond schedule to fulfill his need.

(04 Marks)

iii.

- a. Mr. Sumith invested a certain sum of money in Rs. 2,000 face value bonds of Sigma PLC which promises a semiannual coupon of 10.50%. The bonds mature in 20 years at par, and it was purchased to yield $j_4 = 12\%$. Exactly after 5 years, he decided to sell off the bonds in the secondary market. Mr. Dhanapala purchased the above bonds to yield $j_1 = 9.5\%$. Find the price at which Mr. Sumith sold a bond in the secondary market.

(03 Marks)

- b. A 20-year bond with annual coupons is bought at a premium to yield $j_1 = 9.5\%$. If the amount of principal adjustment in 3rd bond interest payment is Rs. 50, determine the amount of principal adjustment in the 14th payment.

(02 Marks)

- iv. Ms. Sugandi needs to make a payment of Rs. 2,000,000 to Mr. Malith, in two years from now. In order to make this payment, Ms. Sugandi wishes to invest her money today, in bonds and she wanted to avoid reinvestment risk and interest rate risk too. She considers the following two types of bonds currently available in the market.

Bond Type A: 1-year zero coupon bond with a face value of Rs. 1,000

Bond Type B: 3-year coupon bond that pays 12% annual coupon payments and a face value of Rs. 1,000.

The current market interest rate is 15% per annum.

- Calculate the duration of the two types of bonds.
- Calculate the current prices of the two types of bonds.
- Determine the percentage of fund (weights) to be invested in each type of bond.
- Determine the number of bonds to be purchased from each type by Ms. Sugandhi to achieve her objective.

(12 Marks)

(Total 25 Marks)

03.

- Given the probability of having a male baby is equal to the probability of having a female baby, and assuming independent events, determine
 - The probability of having two girls in a family of three children.
 - The probability of all boys in a family of five children.
 - The probability of two girls and then a boy.

(09 Marks)

- ii. A 25-year-old male buys a ten-year insurance policy which promises to pay Rs. 10,000,000 at the end of ten years, if he dies. If the probability of death at age 35 is 0.25 and if $j_1 = 8\%$, what is the fair price for this contract, ignoring expenses.

(02 Marks)

- iii. Mr. Thushan is evaluating two options to take a loan of Rs. 3,000,000 at 14% simple interest from a bank and from a finance company. In both options she has to repay the debt in 3 equal payments: the first at the end of 3 months, the second at the end of 7 months and the third at the end of 12 months. The banks determine the size of an installment by considering today as the focal date where the finance company considers the end of 12 months as the focal date.

- Calculate the value of an installment of the bank
- Calculate the value of an installment of the finance company
- Which option is preferred for Mr. Thushan?

(08 Marks)

- iv. An investor lends Rs. 150,000 and receives a promissory note promising repayment of the loan in 90 days with 12% simple interest. This note is immediately sold to a bank which charges 10% simple interest.

- How much does the bank pay for the note?
- What is the investors profit?
- What is the bank's profit on this investment when the note matures?

(06 Marks)

(Total 25 Marks)

04.

- i. Mr. Amal, a U.S resident have obtained spot rate quotations from two banks in Thailand: Minzu Bank and Sobat Bank. The bid and ask prices of Thai Bhat (THB) for each bank are displayed in the table below.

USD/THB	Minzu Bank	Sobat Bank
Bid	USD 0.0224	USD 0.0228
Ask	USD 0.0227	USD 0.0229

- What type of arbitrage opportunity is available based on the given information?
- What are the steps to be followed by Mr. Amal, with certain amount of USD in hand, to earn an arbitrage profit?

- c. Determine the arbitrage profit that Mr. Amal could generate using USD 100,000 before the rates are adjusted.

(07 Marks)

- ii. An Italian (EUR) has just completed transactions in America (USD) and England (GBP). He is now holding USD 100,000 and GBP 500,000 and wants to convert both amounts to the Euro (EUR).

His currency dealer provides the following quotation:

GBP/USD 0.6488 - 93

USD/EUR 1.3095 - 98

What are his proceeds from the conversion?

(05 Marks)

- iii. A trader holds a European call option on U.S dollars (USD) with a strike price of LKR 350/USD at a premium of LKR 10/USD and with an expiration date three months from now. The option contract is for USD 100,000. At expiration the USD is traded spot at LKR 400.

- At the expiration, what will be the trader's decision regarding exercising of the option? Give reasons.
- Calculate the trader's profit or loss at the expiration.

(06 Marks)

- iv. The current stock price of Mega Plc is Rs. 60. Over each of the next two, three months period it is expected to go up by 10% or down by 5%. The risk-free interest rate is 6% per annum with continuous compounding.

- Prepare a binomial tree with two steps (6 months) to show the possible prices of the stock after six months.
- What is the value of a six-month European call option with a strike price of Rs. 65 using binomial option pricing model.

(07 Marks)

(Total 25 Marks)

05.

- i. Write the following equations in matrix form and solve them by matrix inversion.

$$2X_1 + 4X_2 - X_3 = 3$$

$$X_1 - 3X_2 + 2X_3 = -1$$

$$6X_1 + 5X_2 + X_3 = 5$$

(10 Marks)

- ii. A company produces three products Chairs, Tables and Cupboards. The manufacturing process consists of three operations X, Y and Z. The time taken for each operation and the total number of hours available are given in the following table.

Operation	Chairs	Tables	Cupboards	Total hours
X	1	2	1	8
Y	2	3	4	20
Z	4	3	2	16

Determine the number of chairs, tables and cupboards that can be produced using the inverse matrix method or Cramer's rule.

(15 Marks)

(Total 25 Marks)
