# HERBERT CHITEPO SCHOOL OF LAW AND BUSINESS SCIENCES

## DEPARTMENT OF ECONOMICS AND FINANCE

## EXAMINATION

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| BACHELOR OF COMMERCE | PART 2 SEMESTER 2 |
| COURSE | SIMULATION AND MODELLING FOR FINANCE |
| CODE | HFE419 |
| YEAR | 2024 |
| DATE | |
| DURATION | 3 HOURS |



### INSTRUCTIONS TO CANDIDATES

1. THE PAPER COMPRISES 5 QUESTIONS.
2. YOU ARE REQUIRED TO ANSWER ANY FOUR QUESTIONS.
3. BEGIN THE ANSWER TO EACH QUESTION ON A FRESH PAGE OF THE ANSWER BOOKLET.
4. NON-PROGRAMMABLE FINANCIAL OR SCIENTIFIC CALCULATORS ARE ALLOWED INTO THE EXAMINATION.

A3. An insurance company wants to assess the value of a weather derivatives contract using the binomial tree method in SPSS.

a) Explain the concept of the binomial tree method and its application in pricing derivatives tied to uncertain environmental variables. (8 marks)

b) Additionally, calculate the option prices at each node of a binomial tree for a European call option given specific parameters.
Parameters:

Current stock price (S0) = $50
Exercise price (X) = $55
Risk-free interest rate (r) = 5% per annum
Time to expiration (T) = 1 year
Number of time steps (n) = 3

(12 marks)

c) Describe the steps involved in constructing a binomial tree model for valuing the weather derivatives contract in SPSS, including computations for option valuation, sensitivity analysis, and risk assessment. (6 marks)

A2. A company wants to simulate the spread of a new product in a competitive market using agent based modelling (ABM).

a) Briefly explain the concept of ABM and its advantages for modelling complex systems. (5 marks)

b) Describe the steps involved in building an ABM in MATLAB to simulate the product spread.

Consider factors like consumer behavior, competitor actions, and market saturation. (20 marks)

A3. A financial analyst needs to value a European call option using the binomial tree method in

SPSS.

a) Explain the concept of a binomial tree and its application in option pricing. (10 marks)

b) Describe how you would use SPSS's data manipulation and statistical functions to construct a Binomial tree model for valuing the call option. Include calculations for option price, delta, and

Gamma. (15 marks)

A4. An investment firm wants to use MPT to create an optimal portfolio for a risk-averse client.

Historical data on various asset classes is available in SPSS.

a) Briefly explain the core principles of Modern Portfolio Theory and the concept of the efficient Frontier. (10 marks)

b) Describe the steps involved in using SPSS to perform portfolio optimization based on MPT.

This should include calculating expected returns, variances, covariance, and constructing the optimal portfolio based on risk tolerance. (15 marks)

A5. A bank needs to develop a credit risk model in SPSS to assess the probability of loan default for new applicants.

a) Explain the concept of logistic regression and its advantages for credit risk modelling. (10 marks)

b) Describe how you would use SPSS to build a logistic regression model using historical loan data. Include variable selection, model training, and evaluation metrics like accuracy and AUC

(Area under the ROC Curve). (15 marks)