Master of Science in Quantitative Finance

COURSE CODE: **QF607**
COURSE TITLE: **Numerical Methods**

Instructor : Dr Zhenke Guan
Title : Adjunct Faculty of Quantitative Finance
Email : zhenkeguan@smu.edu.sg

PRE-REQUISITE/CO-REQUISITE/MUTUALLY EXCLUSIVE COURSE(S)
None

COURSE AREA
Quantitative Finance

GRADING BASIS
Graded

COURSE UNIT
1 CU

FIRST OFFERING TERM
Academic Year: AY2024
Academic Term: Term 2

COURSE DESCRIPTION

The objectives of this course are to introduce and implement various numerical methods used by practitioners to solve problems in Quantitative Finance. The topics include implementing derivative pricing by binomial and trinomial trees, finite difference methods and Monte Carlo simulations. Computational techniques such as error analysis will be introduced. FX volatility surface and the local volatility model will be used as the main examples for the application of these numerical methods.

LEARNING OBJECTIVES

By the end of this course, students will be able to:

- Understand numerical methods that are commonly used in Quantitative Finance
- Understand the efficiency and accuracy of numerical methods
- Formulate quantitative models to represent the real life problem situations
- Explain the convention and standard models used in financial market
- Implement numerical methods to accommodate the conventions
- Implement numerical pricers for various popular financial products
- Interpret the results and improve the performance of numerical methods

PRE-REQUISITE/ CO-REQUISITE/ MUTUALLY EXCLUSIVE COURSE(S)

Please refer to the Course Catalogue on OASIS for the most updated list of pre-requisites / co-requisites for this particular course. Do note that if this course has a co-requisite, it means that the course has to be taken together with another course. Dropping one course during BOSS bidding would result in both courses being dropped at the same time.

ASSESSMENT METHODS

Assignments 20%
Course Project 30%
Final exam: 50%

ACADEMIC INTEGRITY

All acts of academic dishonesty (including, but not limited to, plagiarism, cheating, fabrication, facilitation of acts of academic dishonesty by others, unauthorized possession of exam questions, or tampering with the academic work of other students) are serious offences.

All work (whether oral or written) submitted for purposes of assessment must be the student's own work. Penalties for violation of the policy range from zero marks for the component assessment to expulsion, depending on the nature of the offence.

When in doubt, students should consult the course instructor. Details on the SMU Code of Academic Integrity may be accessed at http://www.smuscd.org/resources.html.

ACCESSIBILITY

SMU strives to make learning experiences accessible for all. If you anticipate or experience physical or academic barriers due to disability, please let me know immediately. You are also welcome to contact the university's disability services team if you have questions or concerns about academic provisions: included@smu.edu.sg.

Please be aware that the accessible tables in our seminar room should remain available for students who require them.

EMERGENCY PREPAREDNESS FOR TEACHING AND LEARNING (EPTL)

Where there is an emergency that makes it infeasible to have classes on campus, classes will be conducted online via WebEx, with no disruption to the schedule. To familiarise students with the WebEx platform, part of this course may be conducted online. The instructor will inform students of which classes, if any, will be conducted as part of this EPTL initiative.

INSTRUCTIONAL METHODS AND EXPECTATIONS

Assignments

There will be two assignments throughout the semester. The assignments will focus on the practice of using python programming language to solve numerical problems in derivative pricing.

Group Project

The objective of the project is to prepare students with experience in solving a real life problem in financial market. The students are expected to analyze the problem, formulate it, propose and implement the solution. A written project report will be submitted for evaluation.

Examinations

There will be an open book final exam. No make-up exams will be allowed without prior permission.

You are expected to follow the school's examination policy. Among other things, you need to bring your own calculator(s) to the exams; you are not allowed to share calculator(s) with one another; you also need to silence your cell phone and keep it away from the desk during the entire duration of the exams.

RECOMMENDED TEXT AND READINGS

The course materials will be covered by the lecture notes. The reference papers and books recommended for further readings will be provided in the lecture notes for each topic.

COURSE SCHEDULE (subject to change)

Week 1: Introduction to numerical methods
Week 2-4: Binomial and Trinomial Tree Models
Week 5,6: Root searcher, implied and local volatility surfaces
Week 7,8: Monte Carlo method
Week 9: Finite difference method for solving Partial Differential Equations
Week 10: Numerical Optimization