
COURSE SYLLABUS

FOR FULL-TIME UNDERGRADUATE PROGRAMS

(Issued under Decision No.1380/QĐ-ĐHKTQĐ on 15/8/2016 by the University President)

1. COURSE NAME: Stochastic Simulation

Code: TOTC1102

Number of Credit: 02

2. DEPARTMENT IN CHARGE OF INSTRUCTION:

Department of Mathematical Finance

Office: Faculty of Economic Mathematics

Office Hours: Working hours, the working day

Office Telephone: (84) 04 3628 3007

3. PRE-REQUISITE:

Course pre-requisites: Computer Skills, Foundation of Mathematical Finance.

4. COURSE DESCRIPTION:

✓ Stochastic simulation and applications in finance is an optional subject for 3rd year and 4th year students specialized in applied Mathematics for Economics.

✓ Simulation method is used to study the phenomenon in practice by creating simulation models on computers. The course presents the concepts of random numbers, methods generating discrete and continuous random numbers, methods simulating stochastic processes and applications of stochastic simulation in finance.

5. COURSE OBJECTIVES:

✓ This course provides the basic knowledge of stochastic simulation: Random numbers, simulation method of one dimensional random variables and multidimensional random variables, simulation method of stochastic processes and applications of stochastic simulation in some financial models.

✓ The course provides learners with skills of simulating random variables, stochastic process with the support of software; and application skills of stochastic simulation method in the analysis of some specific financial model.

6. COURSE CONTENT:

TENTATIVE SCHEDULE

| <i>No</i> | <i>Contents</i> | <i>Total hours</i> | <i>In details</i> | | <i>Notes</i> |
|-----------|-----------------|--------------------|-------------------|------------------------------------|---|
| | | | <i>Theory</i> | <i>Practice, Discussion, Exams</i> | |
| 1 | Chapter 1 | 4 | 3 | 1 | <i>Practice with computer software and report in group.</i> |
| 2 | Chapter 2 | 10 | 6 | 4 | |
| 3 | Chapter 3 | 4 | 3 | 1 | |
| 4 | Chapter 4 | 12 | 6 | 6 | |
| | Total | 30 | 18 | 12 | |

CHAPTER 1- SOME KNOWLEDGE OF PROBABILITY

This chapter introduces some basic knowledge of probability to use in subjects such as random variables, stochastic processes, conditional expectation and law of large numbers.

1.1. Random variable

1.1.1. Probability distribution

1.1.2. Characteristic parameters

1.1.3. Some common probability distribution rules

1.2. Stochastic process

1.2.1. Concept of stochastic process

1.2.2. Some stochastic processes

1.3. Conditional expectation

1.4. Law of large numbers

1.4.1. Concept of convergence

1.4.2. Trebusep Theorem

1.4.3. Bernoulli Theorem

1.4.4. Centre Limit Theorem

References of the chapter:

- 1) Phạm Thị Hồng Thắm, *Stochastic Simulation and Applications in Finance Lecture notes.*

- 2) Huu Tue Huynh, Van Son Lai and Issouf Soumaré (2008), *Stochastic Simulation and Applications in Finance with MATLAB program*, John Wiley and Sons.

CHAPTER 2- SIMULATION OF RANDOM VARIABLE

For simulation, firstly, we have to have the random number. This chapter introduces random numbers, simulation method of discrete random variable, simulation method of continuous random variable and simulation method of random vector.

2.1. Random number

2.1.1. Introduction of random number

2.1.2. Uniform random variable generator

2.2. Simulation of discrete random variable

2.2.1. Simulation of general discrete random variable

2.2.2. Simulation for some random variables with specific distribution

2.3. Simulation of continuous random variable

2.3.1. Some methods to simulate continuous random variable

2.3.2. Simulation for some random variables with specific distribution

2.4. Simulation of random vector

2.4.1. Simulation of random vector with independent components

2.4.2. Simulation of random vector with dependent components

2.5. Introduction of MCMC method

2.5.1. Markov process

2.5.2. Content of MCMC method

References of the chapter:

- 1) Phạm Thị Hồng Thắm, *Stochastic Simulation and Applications in Finance Lecture notes*.
- 2) Huu Tue Huynh, Van Son Lai and Issouf Soumaré (2008), *Stochastic Simulation and Applications in Finance with MATLAB program*, John Wiley and Sons.
- 3) John A. D. Appleby, Devid C. Edelman, John J. H. Miller (2008), *Numerical Methods for Finance*, Chapman and Hall.

CHAPTER 3 - MONTE CARLO SIMULATION METHOD

This chapter introduces: concept of Monte Carlo simulation method, evaluation method of Monte Carlo simulation quality, some applications of this simulation method.

3.1. Concept of Monte Carlo simulation method

3.2. Quality of Monte Carlo simulation

3.3. Applications of Monte Carlo simulation method.

References of the chapter:

- 1) Phạm Thị Hồng Thắm, *Stochastic Simulation and Applications in Finance Lecture notes*.
- 2) Huu Tue Huynh, Van Son Lai and Issouf Soumaré (2008), *Stochastic Simulation and Applications in Finance with MATLAB program*, John Wiley and Sons.
- 3) John A. D. Appleby, Devid C. Edelman, John J. H. Miller (2008), *Numerical Methods for Finance*, Chapman and Hall.

CHAPTER 4 – SIMULATION OF STOCHASTIC PROCESS AND APPLICATIONS IN FINANCE

This chapter presents simulation of stochastic process method and performance simulation for some of specific processes: Random walk, Wiener process, Gauss process, Poisson process. At the same time, this chapter presents applications of this method in finance: Simulation of price process, Option pricing, Risk measurement.

4.1. Simulation of stochastic processes

4.1.1. Simulation of random walk

4.1.2. Simulation of Wiener process

4.1.3. Simulation of Gauss process

4.1.4. Simulation of Poisson process

4.2. Application of stochastic simulation in finance

4.2.1. Simulation of price process

4.2.2. Application of stochastic simulation methods for option pricing

4.2.3. Application of stochastic simulation methods for risk measurement

References of the chapter:

- 1) Phạm Thị Hồng Thắm, *Stochastic Simulation and Applications in Finance Lecture notes*.
- 2) George S. Fishman (1996), *Monte Carlo Concepts, Algorithms and Applications*, Springer.
- 3) Huu Tue Huynh, Van Son Lai and Issouf Soumaré (2008), *Stochastic Simulation and Applications in Finance with MATLAB program*, John Wiley and Sons.
- 4) John A. D. Appleby, Devid C. Edelman, John J. H. Miller (2008), *Numerical Methods for Finance*, Chapman and Hall.
- 5) Peter Jackel (2002), *Monte Carlo Methods in Finance*, John Wiley and Sons.

7. REQUIRED TEXTBOOKS & COURSE MATERIALS:

- 1) Phạm Thị Hồng Thắm, *Stochastic Simulation and Applications in Finance Lecture notes*.

8. RECOMMENDED TEXTS & OTHER READINGS:

- 1) George S. Fishman (1996), *Monte Carlo Concepts, Algorithms and Applications*, Springer.
- 2) Huu Tue Huynh, Van Son Lai and Issouf Soumaré (2008), *Stochastic Simulation and Applications in Finance with MATLAB program*, John Wiley and Sons.
- 3) John A. D. Appleby, Devid C. Edelman, John J. H. Miller (2008), *Numerical Methods for Finance*, Chapman and Hall.
- 4) Peter Jackel (2002), *Monte Carlo Methods in Finance*, John Wiley and Sons.

9. ASSESSMENT & GRADING POLICY:

- ✓ Attendance (min 80%): 10%
- ✓ Discussion and homework: Complete teacher's requirement
- ✓ Practice and presentation: 30%
- ✓ Final exam: 60%

Hanoi, 2016

HEAD OF DEPARTMENT

(signed)

PhD. Hoang Duc Manh

PRESIDENT

(signed)

Prof.Dr. Tran Tho Dat