MATH 411

Stochastic Process for Finance

昆山杜克大学
DUKE KUNSHAN UNIVERSITY

Session 4, 2025

Dates and meeting time: Monday and Wednesday, 12:00 pm – 2:30 pm,
Recitation: Thursday 6:00 pm – 7:15 pm (optional)
Location: LIB 2115
Academic credit: 4
Course format: Lecture

Instructor's information

NAME: Dangxing Chen

OFFICE: WRD 2113

EMAIL: dangxing.chen@dukekunshan.edu.cn

OFFICE HOURS: 2:30 pm – 3:00 pm on Monday and Wednesday, 1:30 pm – 2:30 pm on Tuesday

INSTRUCTOR EXPERTISE: Quantitative Finance and Numerical Methods

TEACHING ASSISTANT (only for coding): Jingfeng Chen (jingfeng.chen@dukekunshan.edu.cn)

What is this course about?

This is a course in mathematical models in finance, centered around the problem of building mathematical models for the stock market and its applications in pricing and hedging derivative securities. Due to the uncertainty inherent in the evolution of the stock market, the theory naturally involves probabilistic tools and structures such as conditioning, martingales, and Markov processes. To focus on the main idea, the course works with a simple model so-called binomial asset pricing model for the discrete cases, and the geometric Brownian motion model for the continuous cases, for most of the time. In addition, some finance theories behind and application to empirical data will be discussed.

What background knowledge do I need before taking this course?

Prerequisite: Math 101 or 105, Math 205 or 206

What will I learn in this course?

After successfully completing the course, students will be able to:

1. Understand the rigorous definitions of various concepts in mathematical finance.
2. Attain proficiency in the techniques of working with these concepts by the methods of probability.

3. Develop analytical and computational skills required for working with the mathematical models in finance to solve problems.
4. Connect the mathematical concept to the real world financial market.
5. Understand some rigorous proofs in the field of probability.
6. Express the ideas of the rigorous way to build financial models.
7. Express mathematical ideas in a manner that clearly displays the reasoning leading to precisely specified answers and conclusions.

What will I do in this course?

Students are expected to attend class and actively participate in all classroom, recitation&lab activities.

How can I prepare for the class sessions to be successful?

To succeed, students should be prepared to devote several hours to this course on a daily basis. They are strongly recommend to attend the class on time, read the textbook carefully after each lectures. They are also strongly encouraged to interact with the instructor and the classmates actively both in class and after class. Like all the math courses, the materials in this course cannot be learned passively.

What required texts, materials, and equipment will I need?

Stochastic Calculus for Finance I: The Binomial Asset Pricing Model, Springer-Verlag, New York, 2004.

Stochastic Calculus for Finance II: Continuous-time models, Springer-Verlag, New York, 2004.

Additional materials may be provided by the instructor.

What optional texts or resources might be helpful?

Wikipedia: https://www.wikipedia.org/

How will my grade be determined?

Midterm: Wednesday of the 4th week, in class (5%(take-home coding) + 20%(written) = 25%)

Final: 3:30 pm – 5:30 pm, May 7th (35%)

Homework: Weekly (30%)

Final project (10%)

A+= 98% - 100% **A** = 97% - 93%; **A-** = 90% - 92%; **B+** = 87% - 89%; **B** = 83% - 86%; **B-** = 80% - 82%; **C+** = 77% - 79%; **C** = 73% - 76%; **C-** = 70% - 72%; **D+** = 67% - 69%; **D** = 63% - 66%; **D-** = 60% - 62% **F** = 59% and below

What are the course policies?

In case of documented illness or family emergency or documented University sponsored trips, you may miss the midterm, but the supporting documentation must be submitted to the instructor in advance. With

the document, your missing midterm score can be counted as the same as your final, adjusted by the class median. Do remember: let me know **BEFORE** the exam. An unexcused absence from any exam will be counted as a zero.

Weekly homework will be assigned each Wednesday and will be due on the following Wednesday's lecture. You can either give it to me before the beginning or at the end of the lecture. No late homework will be accepted.

If you have any questions about grading of homework and exams, please let me know within a week once the grade is out. No changes will be made after that.

Communications:
Students can come to office hours provided by the instructor and the TA. Individual appointments can also be made if time doesn't work for students. Emails will be replied promptly. Announcements will be made on Canvas and students are required to check them frequently.

Academic Integrity:
As a student, you should abide by the academic honesty standard of the Duke Kunshan University. Its Community Standard states: "Duke Kunshan University is a community comprised of individuals from diverse cultures and backgrounds. We are dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Members of this community commit to reflecting upon and upholding these principles in all academic and non-academic endeavors, and to protecting and promoting a culture of integrity and trust." For all graded work, students should pledge that they have neither given nor received any unacknowledged aid.

For the homework, collaboration is allowed. But each student must turn in his/her own homework. Direct copy is strictly prohibited, and will be counted as zero.

Academic Policy & Procedures:
You are responsible for knowing and adhering to academic policy and procedures as published in University Bulletin and Student Handbook. Please note, an incident of behavioral infraction or academic dishonesty (cheating on a test, plagiarizing, etc.) will result in immediate action from me, in consultation with university administration (e.g., Dean of Undergraduate Studies, Student Conduct, Academic Advising). Please visit the Undergraduate Studies website for additional guidance related to academic policy and procedures. Academic integrity is everyone's responsibility.

Academic Disruptive Behavior and Community Standard:
Please avoid all forms of disruptive behavior, including but not limited to: verbal or physical threats, repeated obscenities, unreasonable interference with class discussion, making/receiving personal phone calls, text messages or pages during class, excessive tardiness, leaving and entering class frequently without notice of illness or other extenuating circumstances, and persisting in disruptive personal conversations with other class members. Please turn off phones, pagers, etc. during class unless instructed otherwise. Laptop computers may be used for class activities allowed by the instructor during synchronous sessions. If you choose not to adhere to these standards, I will take action in consultation with university administration (e.g., Dean of Undergraduate Studies, Student Conduct, Academic Advising).

Academic Accommodations:
If you need to request accommodation for a disability, you need a signed accommodation plan from Campus Health Services, and you need to provide a copy of that plan to me. Visit the Office of Student Affairs website for additional information and instruction related to accommodations.

What campus resources can help me during this course?

Academic Advising and Student Support
Please consult with me about appropriate course preparation and readiness strategies, as needed. Consult your academic advisors on course performance (i.e., poor grades) and academic decisions (e.g., course changes, incompletes, withdrawals) to ensure you stay on track with degree and graduation requirements. In addition to advisors, staff in the Academic Resource Center can provide recommendations on academic success strategies (e.g., tutoring, coaching, student learning preferences). Please visit the Office of Undergraduate Advising website for additional information related to academic advising and student support services.

Writing and Language Studio

For additional help with academic writing—and more generally with language learning—you are welcome to make an appointment with the Writing and Language Studio (WLS). To accommodate students who are learning remotely as well as those who are on campus, writing and language coaching appointments are available in person and online. You can register for an account, make an appointment, and learn more about WLS services, policies, and events on the WLS website. You can also find writing and language learning resources on the Writing & Language Studio Sakai site.

IT Support

If you are experiencing technical difficulties, please contact IT:

- China-based faculty/staff/students 400-816-7100, (+86) 0512- 3665-7100
- US-based faculty/staff/students (+1) 919-660-1810
- International-based faculty/staff/students can use either telephone option (recommend using tools like Skype calling)
- Live Chat: https://oit.duke.edu/help
- Email: service-desk@dukekunshan.edu.cn

What is the expected course schedule?

Week	Class topic/unit name
Week 1	Efficient market hypothesis
Week 2	The binomial no-arbitrage pricing model (B1: Chapter 1)

Week 3	Probability theory on coin toss space (B1: Chapter 2)
Week 4	More discussions and Midterm
Week 5	General probability theory (B2: Chapter 1.1-1.5), information and conditioning (B2: Chapter 2)
Week 6	Brownian motion and Geoemtric Brownian motion (B2:Chapter 3)
Week 7	Black-Scholes Model (B2: Chapter 5.1)

Note: B1 denotes for the first reference book and B2 denotes for the second reference book in the list