
- **Instructor**: Sergey Nadtochiy (sergeyn@umich.edu, 2854 EH).
- **GSI**: Roman Gayduk (gayduk@umich.edu)
- **Synopsis**: The aim of this course is to teach the probabilistic techniques and concepts from the theory of stochastic processes required to understand the widely used financial models. In particular concepts such as martingales, stochastic integration/calculus, which are essential in computing the prices of derivative contracts, will be discussed. The specific topics include: Brownian motion (Gaussian distributions and processes, equivalent definitions of Brownian motion, invariance principle and Monte Carlo, scaling and time inversion, properties of paths, Markov property and reflection principle, applications to pricing, hedging and risk management, Brownian martingales), martingales in continuous time, stochastic integration (including Ito’s formula), stochastic differential equations (including Feynman-Kac formula), change of measure (including Girsanov’s theorem and change of numeraire), and, time permitting, stochastic control (including Merton problem). Applications from various areas of Finance (including, pricing of derivatives, risk management, etc) are used to illustrate the theory.
- **Prerequisites**: Math 526, Math 573.
- **Textbooks**:
  - **Required**: Stochastic Calculus for Finance II Continuous time models (Shreve). In addition, some lecture notes will be posted in the Resources section of ctools.
  - **Optional**: Stochastic differential equations: an introduction with applications (Oksendal), Stochastic calculus and financial applications (Steele), Brownian motion and stochastic calculus (Karatzas-Shreve).
- **Classes**: Tue/Thu, 8:30-10:00am, except for spring break. First class on Jan 7, last class on Apr 14. Lecture room: 3088 EH.
- **Attendance**: you are strongly encouraged to attend the lectures.
- **Coursework**: **Homeworks** and **final exam**.
  - There will be approximately 6 homeworks (hwks) in the course. You will be given at least two weeks to complete each hwk. The submission deadlines are specified when the hwk is assigned. Completed hwk assignments should be submitted in class or placed into the outside dropbox on the door of room 2854 EH. In case you choose to put your assignment in the dropbox, you should do so during the time period specified when the hwk is assigned (typically two hours before the deadline), to ensure that it is not lost. **The instructor is not responsible for any hwks that are stolen from the dropbox.**
  - Exam is closed-book, but a cheat sheet is allowed, provided its contents comply with the rules (the rules will be posted on ctools before each exam). There will be no makeup exams.
    - **Final exam** is scheduled as follows: Apr 26, 8–10am, in 3088 EH.
  - Hwks and the practice exam, along with their solutions, will be posted in the Resources section of ctools.
• **Grading**: Hwks – 50%, Final – 50%. The final grades will be distributed according to the table contained in the file named ‘grade_options’ and located in the Resources section of ctools. The first column of the table represents the grade, the second column shows the minimum score (in percent) needed to achieve this grade. Note that the distribution of final grades may be curved but only in your favor. In other words, the numbers in the second column may be decreased but they will not be increased.

• **Instructor's office hours**: Tue 10:10am–12:10pm, Thu 10:10–11:10am, in 2854 EH.

• **GSI's office hours**: Thu 3:30–5:30pm, in 4848 EH.

• Tentative course schedule.
  
  – Week 1. Brownian Motion: Gaussian (normal) distributions.
  – Week 2. Brownian Motion: multivariate Gaussian distributions, Gaussian processes, first definition of a Brownian motion, alternative definitions of Brownian motion (via stationary independent increments).
  – Week 3. Brownian Motion: basic properties (scaling, time-reversal and symmetry with respect to zero), invariance principle, martingales in continuous time (definition, optional sampling and martingale convergence), Brownian motion as a martingale (functions of BM as martingales, useful Brownian martingales), quadratic variation of Brownian motion.
  – Week 4. Brownian Motion: properties of Brownian sample paths (nowhere differentiability and the set of zeros), Markov property (definition, Reflection Principle, Bachelier theorem, ruin probability, pricing and hedging of Barrier Options). Hwk 1 assigned.
  – Week 5. Stochastic calculus: rigorous definitions and properties of sigma-algebra, filtration, stopping time, conditional expectation; construction of Ito’s integral.
  – Week 13. Term-Structure models: affine models, HJM, LIBOR.
  – Week 15. Tutorial for the final exam.

**Academic Integrity**: The LSA undergraduate academic community, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. The College holds all members of its community to high standards of scholarship and integrity. To accomplish its mission of providing an optimal educational environment and developing leaders of society, the College promotes the assumption of personal responsibility and integrity and prohibits all forms of academic dishonesty and misconduct. Academic dishonesty may be understood as any action or attempted action that may result in creating an unfair academic advantage for oneself or an unfair academic advantage or disadvantage for any other member or members of the academic community. Conduct, without regard to motive, that violates the academic integrity and ethical standards of the College community cannot be tolerated. The College seeks vigorously to achieve compliance with its community standards of academic integrity. Violations of the standards will not be tolerated and will result in serious consequences and disciplinary action.