DEPARTMENT OF MATHEMATICS, THE UNIVERSITY OF TEXAS AT AUSTIN

Stochastic Processes M394C/CSE394

Fall 2025

Unique course number: 59260/70035.
Class meets: T-TH 12:30 p.m.-2:00 p.m.
Class location: PMA 12.166

Instructor: Mihai Sîrbu
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Office Hours: Tuesday: 11:30am am-12:30 pm and by appointment

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Course description: The course centers on the study of Ito-diffusion processes and their applications. After an introduction to stochastic calculus and stochastic integration with respect to Brownian motion, it develops the theory of stochastic differential equations and their connection to classical analysis. It also exposes the students to optimal stochastic control of diffusion processes, the Hamilton-Jacobi-Bellman equation, singular stochastic control and linear filtering. Some applications, mainly from mathematical finance, inventory theory, decision analysis and insurance will be presented.

Prerequisites/Background:

1. Knowledge of Probability and fundamental concepts of Stochastic Processes.
2. Measure Theory and Real Analysis are highly recommended.
3. The level of the class will be mostly like the one in references 1-3 below (especially 1,2).

Course web-page: All information will be posted on http://canvas.utexas.edu

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Topics covered by the course:

- Review of fundamental concepts in probability
- Martingales and filtrations
- Brownian Motion
- Stochastic Integration
- Stochastic Calculus
- Stochastic Differential Equations
- Feynman-Kac formula and connection with linear PDE
- Introduction to Optimal Stochastic Control
- Introduction to Singular Stochastic Control
- Filtering
- Applications

Suggested literature:

1. **An introduction to Stochastic Differential Equations***, L. C. Evans.
2. "Stochastic Differential Equations, B. Oksendal (6th edition)
3. Brownian Motion and Stochastic Calculus", I. Karatzas and S. Shreve
4. The theory of Stochastic Processes, I, I. Gihman and A. Skorokhod
5. The theory of Stochastic Processes, II, I. Gihman and A. Skorokhod
6. Controlled Markov Processes and Viscosity Solutions" W.H. Fleming and M. Soner

*: The class will mostly follow this text.

Homework/Grade: The grade will be based on homework assignments (approximately 5 assignments during the semester). The homework will be assigned and turned in as PDF through Canvas (most easily by uploading hand-written solution, that can be scanned using a phone).

Students with Disabilities: If you are a student with a disability, or think you may have a disability, and need accommodations, please contact Disability and Access (D&A). You may refer to D&A's website for contact and more information: https://disability.utexas.edu. If you are already registered with D&A, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations.

Additional resources: The University of Texas at Austin has a Counseling and Mental Health Center, located in the Student Services Bldg (SSB), 5th Floor, open M–F 8am–5pm. The contact details are: telephone numbers 512-471-3515 (appointments), 512-471-CALL (crisis line); web-page at https://www.cmhc.utexas.edu.