Syllabus
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MAP 6468 – Stochastic Differential Equations and High-Dimensional Probability

Time and Location: M-W-F, Period 5 (11:45 AM - 12:35 PM), TURL 2328
Instructor: Arnaud Marsiglietti
Office: 410 Little Hall
E-mail: a.marsiglietti@ufl.edu
Course website: https://people.clas.ufl.edu/amarsiglietti/courses/spring24-1/

⟶ The course is on **Canvas**

Office Hours
Monday 10am – 10:50am, Wednesday 10am – 10:50am, or by appointment

Textbook
There is no required text, but the following textbooks are suggested:

- G. F. Lawler, Stochastic Calculus: An Introduction with Applications (**PDF available on Prof. Lawler's website**).
- P. E. Protter, Stochastic Integration and Differential Equations, Springer.
- K. Ball, An elementary introduction to modern convex geometry, Cambridge University Press (**PDF available on Prof. Ball's website**).
- R. Vershynin, High-Dimensional Probability, An Introduction with Applications in Data Science, Cambridge University Press (**PDF available on Prof. Vershynin's website**).

Prerequisites
MAP 6467 — Stochastic Differential Equations

Scope of the Course
The aim of the course is to provide students with strong foundations in the area of probability theory. At the end of the course, students will be acquainted with the language of probability and will gain sufficient experience to successfully apply probabilistic tools to most areas of pure and applied sciences.

The course is intended for graduate students as part of their PhD requirement, and for students considering studying probability theory at a research level.

Topics Covered
Topics include: Stochastic differential equations, Stochastic integral with respect to martingales, Geometric objects in high-dimension, Sphere packing and covering, Dimension reduction: the Johnson-Lindenstrauss lemma, Concentration inequalities.

Weekly Schedule
W1: Brownian motion and PDE.
W2: Construction of stochastic integral with respect to a martingale.
W3: Stochastic differential equations. Existence and uniqueness of solution.
W4: Simulation. Numerical methods.
W5: Change of measure, Girsanov's theorem.
W6: Introduction to high-dimension: distribution of the volume of the Euclidean ball.
W7: John's theorem, Sections of the cube and Dvoretsky's theorem.
W8: Dimension reduction: the Johnson-Lindenstrauss lemma.
W9: Geometry of log-concave distributions.
W10: Bourgain's hyperplane conjecture.
W11: Concentration inequalities.
W12: Sub-Gaussian and sub-exponential distributions.
W13: Concentration for Gaussian and log-concave distributions in $\mathbb{R}^n$.
W14: Shannon entropy. Asymptotic equipartition property and typicality.

Homework
Homework will be assigned on a regular basis, but will not be graded

Grading System
∘ 3 Take Home Exams (dates are tentative)
→ Wednesday, February 7 (Due On Wednesday, February 14)
→ Wednesday, March 20 (Due On Wednesday, March 27)
→ Friday, April 19 (Due On Friday, April 26)

Grading (100 points)		**Scale**	
Attendance/Participation	**25pts**	A = 90+	B− = 75+
Take Home Exam 1	**25pts**	A− = 87+	C+ = 70+
Take Home Exam 2	**25pts**	B+ = 83+	C = 65+
Take Home Exam 3	**25pts**	B = 80+	C− = 60+

Course Policies:

Class Recording - Privacy
Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

UF Masking and Physical Distancing Policy and the Student Behavioral Expectations Policy
These policies require masks to be worn by everyone in a classroom and physical distancing to be practiced. More details can be found at:

https://policy.ufl.edu/policy/masking-and-physical-distancing/

https://policy.ufl.edu/policy/student-behavioral-expectations-in-response-to-covid-19/

Absence from Exams
Missing an exam is permitted **ONLY** for the most compelling reasons. Please notify me **IN ADVANCE**, if possible, if an exam is to be missed. Otherwise you will be given a 0.

Class Attendance
Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:

https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Honor Code
UF students are bound by The Honor Pledge which states: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code". On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code, which can be found at:

https://sccr.dso.ufl.edu/process/student-conduct-code/

specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor in this class.

Students with Disabilities
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center (DRC) by visiting

https://disability.ufl.edu/students/get-started/

It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Students' Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at

https://gatorevals.aa.ufl.edu/students/

Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via

https://ufl.bluera.com/ufl/

Summaries of course evaluation results are available to students at

https://gatorevals.aa.ufl.edu/public-results/

Diversity, Equity, and Inclusion Statements
The Mathematics Department at the University of Florida is committed to diversity and inclusion of all students. We acknowledge, respect, and value the diverse nature, background and perspective of students and believe that it furthers academic achievements.

It is our intent to present materials and activities that are respectful of diversity: race, color, creed, gender, gender identity, sexual orientation, age, religious status, national origin, ethnicity, disability, socioeconomic status, and any other distinguishing qualities.