# MATH-GA 2704 – Applied Stochastic Analysis

## Spring 2024 Syllabus

## Logistics

*Lecture Times:* M 11AM–12:50PM, CIWW 1302

*Instructor:* **Jonathan Weare** – weare@nyu.edu
Office Hours: TBD, CIWW 1302

*Main source materials:*
E, Li, and Vanden-Eijnden, "Applied Stochastic Analysis"
My notes, available under "content" on Brightspace

*Grading:* Regular written and programming exercises (50%), Final project (50%)

## Course Description

This is a graduate class that will introduce major topics in stochastic analysis from an applied mathematics perspective. Topics to be covered include Markov chains, stochastic processes, stochastic differential equations, numerical algorithms, and asymptotics. It will pay particular attention to the connection between stochastic processes and PDEs, as well as to physical principles and applications. The class will attempt to strike a balance between rigour and heuristic arguments: it will assume that students have some familiarity with measure theory and analysis and will make occasional reference to these, but many results will be derived through other arguments. The target audience is PhD students in applied mathematics, who need to become familiar with the tools or use them in their research.

## Course Prerequisite

Basic Probability (or equivalent masters-level probability course), Linear Algebra (graduate course), and (beginning graduate-level) knowledge of ODEs, PDEs, and analysis.

## Homework policy

Homework will be assigned regularly via Gradescope.

You will upload the written portion of your assignments **in pdf form only** on Gradescope. Make sure to map the assigned problems to the page on which they appear in your submission.

You will upload the code portion of your assignments (**to be completed in Python**) on Gradescope as a single zipped folder. The zipped folder should include a README.txt file explaining how to run the code, that includes explaining any inputs and outputs. The code should be easy to run and output the same numbers in your written report.

You may discuss the homework with other students with the following restrictions:

- You must make an honest attempt at homework problems before discussing them with anyone else.
- You must **do the final write-up independently in your own words**
- You may compare final answers with others to check for mistakes.
- If you receive substantial help on a problem, **you must acknowledge it**. This will not result in any penalty.

## Final project

We will not have a final exam. Instead I will ask you to select a paper broadly in the area of applied stochastic processes and to write a full report describing the results in the paper. In addition to the description of the work, your report should include some computational experiments testing the ideas in the paper. Your grade on the project will be determined not only by the content and thoroughness of your report, but also the clarity of your presentation.

## Other resources

For more on the mathematics of stochastic processes you might start with "Stochastic Processes," by Varadhan

For more on Monte Carlo you might start with "Monte Carlo Strategies in Scientific Computing," by Jun Liu

For more on stochastic approximation you might start with "Stochastic Approximation and Recursive Algorithms and Applications," by Kushner and Yin

For more on stochastic chemical kinetics you might start with "Stochastic Analysis of Biochemical Systems," by Anderson and Kurtz