UNIVERSITY OF WYOMING | MATH 5490-Fall 2009 | Department of Mathematics

Stochastic Methods in Applied Sciences

SYLLABUS

Instructor

Stefan Heinz — Ross Hall 214, 766-4203, heinz@uwyo.edu
URL: http://www.uwyo.edu/heinz/
Office hours: M 10:00-10:50 am, W 10:00-10:50 am, F 10:00-10:50 am.
Also available by appointment, and often by simply dropping by.

Class Meeting

MW 1:20–2:35 pm in Ross Hall 247

Course Objective

Many recent developments in science and technology would not have been possible without having the support of analysis, modeling and simulation methods. Most of these methods do not account for randomness. However, many relevant problems cannot be solved in this way:
- Observations are always noisy: there is the need to quantify the variations of data.
- Rates of processes are often not well known: there is the need to model uncertainties.
- Conservation laws for multi-scale phenomena are often not exactly known: there is the need to explain the origin and suitability of conservation laws.
- Many processes (e.g. nanoscale processes) cannot be described by conservation laws: there is the need to explain the dynamics of such processes.
- Multi-scale problems are often described by high-dimensional partial differential equations that cannot be solved by deterministic techniques: there is the need to solve such equations.

The course objective is to explain the basics and to enable the use of stochastic methods for the solution of real world problems. Specific course features are the following ones:
- Not all available stochastic methods will be discussed: the focus is on methods that are highly relevant to applications.
- Many applications of stochastic methods will be presented: e.g. population dynamics, molecular dynamics, fluid flow, diffusion and stochastic finance problems will be discussed.
- Knowledge of calculus III and basic knowledge of software for performing simple numerical calculations are required. Knowledge of differential equations will be helpful.
- Knowledge of stochastic methods is not needed: all relevant knowledge will be provided.

Course Topics

1) Stochastic Variables
2) Stochastic Discrete Evolution
3) Stochastic Continuous Evolution
4) Stochastic Modeling and Scale

Prerequisites

1) Grade of C or better in Calculus III.
2) Basic knowledge of the use of software to perform simple numerical calculations.
3) Basic knowledge of ordinary and partial differential equations will be helpful.

Textbook You may use the following books for further reading. Please note that we will not closely follow these books.

1) Ross, S., A First Course in Probability. Pearson Prentice Hall, 8th edition, Upper Saddle River, New Jersey (2009).
2) Heinz, S., Statistical Mechanics of Turbulent Flows. Springer-Verlag, Berlin, Heidelberg, New York, Tokyo (2003).

Grading Scheme

50%	Homework
50%	Final Exam

Grade Requirements

A	> 90%
B	> 80%
C	> 70%
D	> 60%
F	< 60%

Homework: Homework is the most vital part of this course. Mathematics, more than most subjects, is one which you learn not by listening and absorbing, but by trying out yourself. The learning of mathematics is also more sequential than that of other subjects ... so all the more need to be regular in doing problems yourself! Homework assignments will be assigned approximately once in two weeks, and will be submitted to me on the specified due date (usually one week after the assignment), at the end of class. It is fine for you to discuss the homework with other students. However, please do not copy anyone else's work directly. Copying may adversely affect your grade; but more importantly, you won't be adequately preparing yourself for the tests in this way. If there are very good reasons that you could not submit your homework on the specified due date, you may talk to me and turn in your homework later but before I returned the graded homework. Homework submitted later than this return day will not contribute to your grade.

Tests: There will be one final exam which will be comprehensive.
The finals week is December 7-11.

Attendance/Participation: I strongly recommend class participation and attendance and consider this activity essential in determining borderline grades.

Disability statement: If you have a physical, learning, or psychological disability and require accommodations, please let me know as soon as possible. You will need to register with, and provide documentation of your disability to, University Disability Support Services (UDSS) in SEO, room 330 Knight Hall, 766-6189, TTY: 766-3073.