

UNIVERSITY OF WYOMING

MATH 5490 02

Principles of Stochastic Modeling (3 credit hours)

Ross Hall 247

Spring 2025

MWF 11:00 am - 12:15 pm

Instructor contact information:

Dr. Stefan Heinz, Ross Hall 214, 766-4203, heinz@uwyo.edu

Office hours:

TR 12:15 – 1:30 pm

Course prerequisites, co-requisites, enrollment restrictions:

Grade of C or better in MATH 2210. Knowledge of the use of software to perform relatively simple numerical calculations. Knowledge of ordinary and partial differential equations will be helpful. Prior knowledge of stochastic methods is not needed.

Course Description:

Many developments in science and technology require it to account for randomness:

- 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 complicated 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 theoretical basics and to enable the use of stochastic methods for the solution of real world problems. The focus is on stochastic methods that are most relevant to applications (molecular dynamics, fluid flow, diffusion and population ecology problems).

Student Learning Outcomes:

Understanding of basic probabilistic concepts and their application to real-world modeling.

Recommended texts, readings, and special tools or materials:

- 1) Heinz, S., Mathematical Modeling. Springer-Verlag, Heidelberg, Dordrecht, London, New York (2011).
- 2) Ross, S., A First Course in Probability. Pearson Prentice Hall, 8th edition, Upper Saddle River, New Jersey (2009).

Course Topics:

- 1) Stochastic States
- 2) Stochastic Changes
- 3) Stochastic Evolution
- 4) Stochastic Multivariate Evolution

General requirements and expectations for the course:

Homework is a 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 will be submitted to me on the specified due date (usually one week later), 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 tests in this way. If there are very good reasons that you could not submit your homework on the specified due date, you may 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.

Required examinations, assignments, activities, and projects:

There will homework assignments and the need to present a research paper.

Final Examination or Final Project Date:

TBA

Grading Scale and Grading Policies:**Grading Scheme**

50%	Homework
50%	Research Papers

Grade Requirements

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

Attendance and Absence policies:

I strongly recommend class participation and attendance and consider this activity essential in determining borderline grades. University policies on excused absences as outlined in [UW Regulation 2-108 \(Student Attendance Policy\)](#).

Classroom Behavior Policy:

At all times, treat your presence in the classroom and your enrollment in this course as you would a job. Act professionally, arrive on time, pay attention, complete your work in a timely and professional manner, and treat all deadlines seriously. You will be respectful towards your classmates and instructor. Spirited debate and disagreement are to be expected in any classroom and all views will be heard fully, but at all times we will behave civilly and with respect towards one another. Personal attacks, offensive language, name-calling, and dismissive gestures are not warranted in a learning atmosphere. As the instructor, I have the right to dismiss you from the classroom and other areas where disruptive behavior occurs. Electronic devices such as mobile phones should be set to silent.

Classroom Statement on Diversity:

The University of Wyoming values an educational environment that supports students of all backgrounds and viewpoints. Diversity of viewpoints is considered a resource for learning. Topics may be difficult, not only intellectually but emotionally; however, discussions are essential to meeting the course's student learning outcomes and assisting students in developing problem-solving and critical-thinking skills. During all conversations, respect and civility are of utmost importance.

Disability Support:

The University of Wyoming is committed to providing equitable access to learning opportunities for all students. If you have a disability, including but not limited to physical, learning, sensory or psychological disabilities, and would like to request accommodations in this course due to your disability, please register with and provide documentation of your disability as soon as possible to Disability Support Services (DSS), Room 128 Knight Hall. You may also contact DSS at (307) 766-3073 or udss@uwyo.edu. It is in the student's best interest to request accommodations within the first week of classes, understanding that accommodations are not retroactive. Visit the DSS website for more information at: www.uwyo.edu/udss.

Academic Dishonesty Policies:

Academic dishonesty will not be tolerated in this class. Cases of academic dishonesty will be treated in accordance with UW Regulation 2-114. The penalties for academic dishonesty can include, at my discretion, an "F" on an exam, an "F" on the class component exercise, and/or an "F" in the entire course. Academic dishonesty means anything that represents someone else's ideas as your own without attribution. It is intellectual theft – stealing - and includes (but is not limited to) unapproved assistance on examinations, plagiarism (use of any amount of another person's writings, blog posts, publications, and other materials without attributing that material to that person with citations), or fabrication of referenced information. Facilitation of another person's academic dishonesty is also considered academic dishonesty and will be treated identically.

Duty to Report:

UW faculty are committed to supporting students and upholding the University's non-discrimination policy. Under Title IX, discrimination based upon sex and gender is prohibited. If you experience an incident of sex- or gender-based discrimination, we encourage you to report it. While you may talk to a faculty member, understand that as a "Responsible Employee" of the University, the faculty member **MUST** report information you share about the incident to the university's Title IX Coordinator (you may choose whether you or anyone involved is identified by name). If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are people who can meet with you. Faculty can help direct you or you may find info about UW policy and resources at <http://www.uwyo.edu/reportit>. You do not have to go through the experience alone. Assistance and resources are available, and you are not required to make a formal complaint or participate in an investigation to access them.

Substantive changes to syllabus:

All deadlines, requirements, and course structure is subject to change if deemed necessary by the instructor. Students will be notified verbally in class, on our WyoCourses page announcement, and via email of these changes."

Student Resources:*DISABILITY SUPPORT SERVICES:*

udss@uwyo.edu, 766-3073, 128 Knight Hall, www.uwyo.edu/udss

COUNSELING CENTER:

uccstaff@uwyo.edu, 766-2187, 766-8989 (After hours), 341 Knight Hall, www.uwyo.edu/ucc

ACADEMIC AFFAIRS:

766-4286, 312 Old Main, www.uwyo.edu/acadaffairs

DEAN OF STUDENTS OFFICE:

dos@uwyo.edu, 766-3296, 128 Knight Hall, www.uwyo.edu/dos

UW POLICE DEPARTMENT:

uwpd@uwyo.edu, 766-5179, 1426 E Flint St, www.uwyo.edu/uwpd

STUDENT CODE OF CONDUCT WEBSITE:

www.uwyo.edu/dos/conduct