Term Information

Effective Term	Autumn 2023

General Information

Course Bulletin Listing/Subject Area	Statistics
Fiscal Unit/Academic Org	Statistics - D0694
College/Academic Group	Arts and Sciences
Level/Career	Graduate
Course Number/Catalog	7541
Course Title	Advanced Stochastic Processes
Transcript Abbreviation	Adv Stoch Proc
Course Description	Markov chains, Point processes, Gaussian processes, Brownian motion, diffusion processes, and other stochastic processes with emphasis on applications and simulation. Intended primarily for students in the PhD program in Statistics or Biostatistics.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week, 7 Week, 6 Week, 4 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Prerequisites: STAT 7201 or permission of instructor
Exclusions	
Electronically Enforced	No

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	27.0501
Subsidy Level	Doctoral Course
Intended Rank	Masters, Doctoral

Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors
The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Write probability models for a variety of dependent data generating processes and anticipate the typical behaviors of these models.
- Perform inference and prediction in the context of stochastic processes using appropriate statistical methods.
- Numerically simulate stochastic processes in discrete and continuous spaces.
- Use a stochastic process as a tool to sample from a complex or unknown probability distribution.

Content Topic List

- Introduction to stochastic processes
- Markov chains
- Point processes
- Gaussian Processes
- Brownian motion
- Ito integral
- Diffusion processes
- Applications
- Computation and simulation

Sought Concurrence

No

Attachments

- STAT7541_syllabus.pdf: Syllabus

(Syllabus. Owner: Craigmile,Peter F)

Comments

- This is a new course in the PhD in Statistics program. *(by Craigmile,Peter F on 11/29/2022 07:33 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Craigmile,Peter F	12/02/2022 08:33 AM	Submitted for Approval
Approved	Craigmile,Peter F	12/02/2022 05:27 PM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	12/03/2022 09:19 PM	College Approval
Pending Approval	Cody,Emily Kathryn Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	12/03/2022 09:19 PM	ASCCAO Approval

THE OHIO STATE UNIVERSITY

College of Arts & Sciences
Department of Statistics

SYLLABUS: STAT 7541

Advanced Stochastic Processes
Spring 2024 (full semester)
3 credit hours

COURSE OVERVIEW

Instructor

<NAME TO BE ANNOUNCED>

Email address: <TO BE ANNOUNCED>

Lectures: 3 classes a week with 55 minute lectures. <LOCATION TO BE ANNOUNCED>

Office hours: <TO BE ANNOUNCED>

Graduate teaching assistant

<NAME>

Email address: <TO BE ANNOUNCED>

Office hours: <TO BE ANNOUNCED>

Prerequisites

STAT 7201 or permission of the instructor.

Course description

This course is an introduction to stochastic processes with emphases on applications, computations and data analyses. Students will learn about foundational models for dependent collections of random variables and computational methods for sampling. Topics include Markov chains, point processes, Gaussian processes, Brownian motion and stochastic differential equations. Other topics in stochastic processes will be covered as time permits, such as sequential Monte Carlo and exact sampling.

Course learning outcomes

By the end of this course, students should successfully be able to:

- Write probability models for a variety of dependent data generating processes and anticipate the typical behaviors of these models.
- Perform inference and prediction in the context of stochastic processes using appropriate statistical methods.
- Numerically simulate stochastic processes in discrete and continuous spaces.
- Use a stochastic process as a tool to sample from a complex or unknown probability distribution.

COURSE MATERIALS AND TECHNOLOGIES

Textbooks

Required

A. R. P. Dobrow (2016), Introduction to Stochastic Processes with R, Wiley. (https://onlinelibrary-wiley-com.proxy.lib.ohio-state.edu/doi/book/10.1002/9781118740712)

B. M. A. Pinsky & S. Karlin (2011), An introduction to stochastic modeling, 4th Edition, Elsevier Inc. (https://www-sciencedirect-com.proxy.lib.ohio-state.edu/book/9780123814166/an-introduction-to-stochastic-modeling)

C. S. M. Iacus (2008), Simulation and Inference for Stochastic Differential Equations, Springer Series in Statistics. (https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007/978-0-387-75839-8)

Recommended/optional

D. N. Chopin & O. Papaspiliopoulos (2020), An Introduction to Sequential Monte Carlo, Springer Series in Statistics. (https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007/978-3-030-47845-2)

E. L. Devroye (1986), Non-uniform random variate generation, Springer. (https://link.springer.com/book/10.1007/978-1-4613-8643-8)

Necessary Software

- This class requires you to use the statistical software packages called R (The R Project for Statistical Computing; http://www.r-project.org/) and RStudio (https://posit.co). These

software packages are available as Free Software. More details will be given in lectures.

GRADING AND FACULTY RESPONSE

ASSIGNMENT CATEGORY	PERCENTAGE
Homework	**35**
Exam 1	**20**
Exam 2	**20**
Final	**25**
Total	**100**

Homework will be assigned approximately weekly and submitted for grading via Carmen.

Exams will be delivered in person during class time.

The **Final** exam will take place during exam week.

Late assignments

<Policy will be added when the course is offered>

Instructor feedback and response time

<Policy will be added when the course is offered>

COURSE SCHEDULE (EXAMPLE)

Refer to the Carmen course for up-to-date assignment due dates. In the Reading column, books are referred to by letter in book list, so A = Dobrow, B = Pinskey & Karlin, etc.

Week	Dates	Topics	Reading	Homework
1	1/6/25 – 1/10/25	Introduction to stochastic processes, Definition & examples of Markov chains, transition probabilities	A ch 1-2	
2	1/13 – 1/17	Strong Markov Property, hitting times, classification of states	A 3.3-3.5, 3.9	
3	1/22 – 1/24	Stationary measures/distributions, Limit behavior, rates of convergence	A 3.1-3.2, 3.6-3.9, 5.5	Homework 1 due
4	1/27 – 1/31	Branching processes, Applications and simulation	A 4.2-4.4, 2.5, 5.1-5.3	Homework 2 due
5	2/3 – 2/7	Poisson process: definitions and simulation *[Exam 1]*	A chapter 6	Exam 1
6	2/10 – 2/14	Cox process: definition, simulation and inference	B 5.1.4, 6.7	Homework 3 due
7	2/17 – 2/21	Gaussian processes: definition, path properties, simulation	A 8.3, B	Homework 4 due
8	2/24 – 2/28	Gaussian processes: prediction, inference		Homework 5 due
9	3/3 – 3/7	Brownian motion: definition, path properties, computations		Homework 6 due
	3/10 – 3/14	*Spring Break*		
10	3/17 – 3/21	Ito integral: definition and Ito formula. *[Exam 2]*		Exam 2
11	3/24 – 3/28	Stochastic Differential Equations: numerical methods, simulation, inference		Homework 7 due
12	3/31 – 4/4	Applications of SDEs and/or Gaussian processes		Homework 8 due
13	4/7 – 4/11	Sequential Monte Carlo: introduction, state space models		Homework 9 due

Week	Dates	Topics	Reading	Homework
14	**4/14 – 4/18**	**Sequential Monte Carlo: Hidden Markov models, filtering, applications**		**Homework 10 due**
15	**4/21**	**Applications of sequential Monte Carlo**		

OTHER COURSE POLICIES

Academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct **http://studentlife.osu.edu/csc/**.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.
If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.
Other sources of information on academic misconduct (integrity) to which you can refer include:

- Committee on Academic Misconduct web page (go.osu.edu/coam)
- Ten Suggestions for Preserving Academic Integrity (go.osu.edu/ten-suggestions)

Copyright for instructional materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu

Commitment to a diverse and inclusive learning environment

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Land Acknowledgement

We would like to acknowledge the land that The Ohio State University occupies is the ancestral and contemporary territory of the Shawnee, Potawatomi, Delaware, Miami, Peoria, Seneca, Wyandotte, Ojibwe and Cherokee peoples. Specifically, the university resides on land ceded in the 1795 Treaty of Greeneville and the forced removal of tribes through the Indian Removal Act of 1830. I/We want to honor the resiliency of these tribal nations and recognize the historical contexts that has and continues to affect the Indigenous peoples of this land.

More information on OSU's land acknowledgement can be found at https://mcc.osu.edu/about-us/land-acknowledgement

Your mental health

As a student you may experience a range of issues that can cause barriers to learn, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. **SLDS contact information:** slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This course requires use of CarmenCanvas (Ohio State's learning management system) and other communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- Canvas accessibility (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- CarmenZoom accessibility (go.osu.edu/zoom-accessibility)