Syllabus for MATH 5763, Introduction to Stochastic Processes, Sec. 001
Spring 2019

Lectures: Tue & Thu 1:30-2:45 p.m. in 809 PHSC

Class web page: `http://www2.math.ou.edu/~npetrov/math5763_s19.html`

Instructor: Prof. Nikola Petrov, `npetrov@ou.edu`, 1101 PHSC

Office Hours: Mon 2:30–3:30, Wed 10:30–11:30 (subject to change), or by appointment, in 1101 PHSC

Description from the Course Catalog: Prerequisite: 4733 or permission of instructor. Stochastic processes in discrete time including random walks, recurrent events, Markov chains and branching processes. Processes in continuous time including linear and nonlinear birth-death processes and diffusions. Applications taken from economics, engineering, operations research.

Prerequisites: Basic calculus-based probability theory (including axioms of probability, random variables, expectation, probability distributions, independence, conditional probability). The class will also require knowledge of elementary analysis (including sequences, series, continuity), linear algebra (including linear spaces, eigenvalues, eigenvectors), and ordinary differential equations.

Course description: The theory of stochastic processes studies systems that evolve randomly in time; it can be regarded as the "dynamical" part of probability theory. It has many important practical applications, as well as in other branches in mathematics such as partial differential equations. This course is a graduate-level introduction to stochastic processes, and should be of interest to students of mathematics, statistics, physics, engineering, and economics. The emphasis will be on the fundamental concepts, but we will avoid using the theory of Lebesgue measure and integration in any essential way. Many examples of stochastic phenomena in applications and some modeling issues will also be discussed in class and given as homework problems.

Texts: We may use parts of the following books, freely available from the OU Libraries web-site for OU students:

[L] M. Lefebvre. *Applied Stochastic Processes.* Springer, 2007

[BZ] Z. Brzeźniak, T. Zastawniak. *Basic Stochastic Processes.* Springer, 1999

[P] E. Parzen. *Stochastic Proceses.* SIAM, 1999

[D] R. Durrett. *Essentials of Stochastic Processes.* Second ed., Springer, 2012

[R] S. Ross. *Introduction to Probability Models.* Eighth ed., Elsevier, 2003

Grading: Your grade will be based on the following:

Homework (lowest grade dropped)	50 %
Take-home midterm exam	20 %
Take-home final exam	30 %

Main topics (a tentative list):

- a brief review of probability theory;
- discrete Markov chains: Chapman-Kolmogorov equations, persistence and transience, generating functions, stationary distributions, reducibility, limit theorems, ergodicity;

- continuous Markov processes: Poisson process, birth-death and branching processes, embedding of a discrete-time Markov chain in a continuous-time Markov processes;
- conditional expectation, martingales;
- stationary processes (autocorrelation function, spectral representation);
- renewal processes, queues;
- diffusion processes, Wiener processes (Brownian motion);
- introduction to stochastic differential equations, Itô calculus;
- Fokker-Planck equation, Ornstein-Uhlenbeck process.

Attendance: You are expected to attend all lectures, and you are responsible for all information given out during them. You are expected to arrive on time for the lectures, properly prepared and in good physical condition – in particular, adequately rested and up to date on the course material – so that you can maintain full concentration for the entire lecture.

All electronic equipment should be turned off before the start of every lecture, and should remain off until the class is dismissed. Since learning calculus requires your full attention, activities such as *conversing with other students, eating, sleeping, reading a newspaper, listening to headsets, using computers, cell phones, or other electronic devices, are not allowed!*

Homework: The homework assignments will be given on the class web site. Your homework solutions must be turned in at the beginning of class on the due date. Giving just an answer to a problem is not worthy any credit – you have to write a complete solution which gives your step-by-step reasoning and is written in grammatically correct English. Your lowest homework grade will be dropped.

The problems in your homework should be in the order listed in the assignment, sheets should be standard-size and should be stapled. No late homework will be accepted!

You are encouraged to discuss the homework problems with other students, but you should write up the solutions in your own words. Copying solutions from a solutions manual, from someone else's work, or from the Internet is a waste of time.

Exams: There will be a take-home midterm exam (given around the 10th week of classes) and a take-home final exam.

Some important dates:

(1) First day of classes: Monday, January 14.

(2) Last day to withdraw with an automatic W: Friday, April 12 for undergraduate students, and Friday, February 22, for graduate students.

(3) Petition to the Dean to drop courses (with a grade of W or F): Monday, April 15 – Friday, May 3 for undergraduate students, and Monday, April 1 – Friday, May 3 for graduate students.

(4) Spring break (no classes): March 16–24.

(5) Last day of classes: Friday, May 3.

Policy on *W/I* grades: Through the end of the sixth week of the semester, students can withdraw from the course with an automatic W. Between the seventh and tenth weeks of the semester, undergraduate students can continue to withdraw with an automatic W, but graduate students must obtain the instructor's signature on the University's "drop form" to withdraw from the course, and along with the signature the

instructor must indicate whether the student is passing or failing at the time of the withdrawal. After the tenth week of the semester, all students can only withdraw via petition to the Dean of their college. The petition process also requires the instructor's signature with a passing-failing indication at the time the petition is filed. Note that a "failing" indication on the petition means that even if the petition is approved the grade in the course will be weighted in the GPA as an F.

The grade of I is not intended to serve as a benign substitute for the grade of F, and is only given if a student has completed the majority of the work in the course at a passing level (for example everything except the final exam), the course work cannot be completed because of compelling and verifiable problem beyond the student's control, and the student expresses a clear intention of making up the missed work as soon as possible. Moreover, current OU policies require that instructors and the affected students execute a written "Incomplete Contract" before a grade of I can be given. The contract makes clear: (1) what work is to be made up; (2) when the make-up work must be completed (which cannot be more than one calendar year from the assignment of the I); and (3) *what alternative grade will be assigned if the make-up work is not completed*. If the make-up work specified in the contract is not made up within one calendar year, then the alternative grade specified in the contract will be entered on the student's transcript. Thus the I grade does not became permanent on the transcript if it is not made up within one year.

Academic Misconduct: All cases of suspected academic misconduct will be reported to the Office of Academic Integrity Programs as possible violations of University's Academic Integrity Code. If the violation is confirmed by the Academic Integrity Program's Office, the penalties can be quite severe, so the best advice is **Don't do it!** For more details on the University's policies concerning academic misconduct consult the link

`http://integrity.ou.edu/students.html`

This link also has information about admonitions (essentially warnings about potential misconduct for fairly minor infractions) and your rights to appeal charges of academic misconduct.

Students are also bound by the provisions of the *OU Student Code*, available at

`https://www.ou.edu/content/dam/studentlife/documents/AllCampusStudentCode.pdf`

Students with disabilities: The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the instructor as early in the semester as possible. Students with disabilities must be registered with the Office of Disability Services prior to receiving accommodations in this course. The Office of Disability Services is located in Goddard Health Center, Suite 166: phone 405–325–3852 or TDD (only) 405–325–4173.