Syllabus for MATH 5763, Introduction to Stochastic Processes, Sec. 990

Fall 2015

Lectures: Tue 1:30–4:20 p.m., Classroom Building 3104

Instructor: Prof. Nikola Petrov, `npetrov@ou.edu`, 802 PHSC, office phone 325-4316

Class web page: `http://www2.math.ou.edu/~npetrov/math5763_f15.html`

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.* 2nd ed., Springer, 2012

[R] S. Ross. *Introduction to Probability Models.* 8th 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.

Some important dates:

(1) First day of classes: Monday, August 24, 2015.
(2) Labor day holiday (no classes): Monday, September 7, 2015.
(3) Last day to withdraw with an automatic W: Friday, October 30, 2015 for undergraduate students and Friday, October 2, 2015 for graduate students.
(4) Last day to withdraw without petition to the Dean: Friday, October 30, 2015 (for graduate students a W/F grade is assigned for withdrawals processed during the period October 5–October 30).
(5) OU-Texas football game holiday: Friday, October 9, 2015.
(6) Thanksgiving break (no classes): November 25–27, 2015.
(7) Last day of classes: Friday, December 11, 2015.

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 referred to the Dean of the College of Arts and Sciences for prosecution under the OU Academic Misconduct Code. The penalties can be quite severe. *Don't do it!* For more details on the OU policies concerning academic misconduct see

`http://integrity.ou.edu/files/Academic_Misconduct_Code.pdf`

This link also has information about students' rights to appeal charges of academic misconduct. For information about admonitions (either accepting or contesting them) see

`http://integrity.ou.edu/files/Admonition.pdf`

Students are also bound by the provisions of the *OU Student Code*, which can be found at

`http://judicial.ou.edu/content/view/27/32/`

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.

Caminante, son tus huellas	Traveler, your footsteps
el camino y nada más;	are the road and nothing more;
caminante, no hay camino,	traveler, there is no road,
se hace camino al andar.	the road is made by walking.
Al andar se hace camino,	By walking the road is made
y al volver la vista atrás	and when we turn to look back
se ve la senda que nunca	we see the path that
se ha de volver a pisar.	will never be traveled again.
Caminante, no hay camino,	Traveler, there is no road,
sino estellas sobre la mar.	only tracks of foam on the sea.

From *Proverbios y Cantares*, Antonio Machado (1875–1939)