DEPARTMENT OF MATHEMATICS, NORTHEASTERN UNIVERSITY

MATH 7241: PROBABILITY 1

SPRING 2014

Version: January 8, 2014

Class: MW 5:50–7:20pm, **Richards Hall (RI) 231**
Instructor: Leonid Petrov
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email: l.petrov@neu.edu (preferred), lenia.petrov@gmail.com
Office hours: Monday 10:30–12:00, Wednesday 12:30–2:00, or *by appointment* (I encourage you to make as many appointments as you need if you have a scheduling conflict with my official hours. The preferred way to make them is by email.)

Course webpage: I will put course material on my homepage http://www.northeastern.edu/petrov/7241S14/. Grades will be posted on the Blackboard.

Texts:

1. "Introduction to Probability", C.M. Grinstead and J.L. Snell. This work is freely accessible under the terms of the GNU Free Documentation License at http://www.math.dartmouth.edu/~prob/prob/prob.pdf
2. Supplementary notes on Probability will be available on my homepage

Optional books: Jim Pitman "Probability"; Rick Durrett "Probability: Theory and Examples"; Jeffrey Rosenthal "A First Look at Rigorous Probability Theory". It is absolutely not required that you purchase these optional books.

Grading:
Homework problems will be assigned and graded each week or two. There will be a midterm test (most likely on **February 26**, the last day before the Spring reak), and a final exam.

Topics:

I. Basics. Limit theorems. Rigorous foundations.
events, probability law, additivity, conditional probability and independence, discrete random variables, expected value, IID sequences and random walks, binomial distribution and Stirling formula, weak law of large numbers, normal distribution, central limit theorem, large deviations, algebras and σ-algebras, Kolmogorov axioms, Borel-Cantelli Lemmas, strong law of large numbers, $0-1$ laws

II. Markov chains.
Markov property, transition matrix, classification of states and of Markov chains, stationary distribution, Perron-Frobenius theorem for finite state spaces, spectral gap, absorbing chains, sojourn times for ergodic chains, fundamental matrix, infinite state space Markov chains, time reversible chains, branching processes

III. Random variables, expectation, conditioning.
σ-algebra, measurable functions and maps, Borel sets, Lebesgue measure, Lebesgue integral, cdf, joint distributions, conditioning, Poisson processes and random fields

IV. Continuous-time Markov chains.
semigroup and transition matrix, queues, birth-death processes

V. Brownian motion. Diffusions.
Brownian motion and its properties, relation to the random walk, functions of Brownian motion

VI. Applications.
Population models and dynamics, random matrices and Dyson Brownian motion

Classes calendar:

week 1. 1/6 and 1/8
week 2. 1/13 and 1/15
week 3. 1/22 (*)
week 4. 1/27 and 1/29
week 5. 2/3 and 2/5
week 6. 2/10 and 2/12
week 7. 2/19
week 8. 2/24 and 2/26
week 9. 3/10 and 3/12
week 10. 3/17 and 3/19
week 11. 3/24 and 3/26
week 12. 3/31 and 4/2
week 13. 4/7 and 4/9
week 14. 4/14 and 4/16

No classes: 1/20 and 2/17
Spring break: 3/3 and 3/5, no classes
1/27: Last day to drop class without W grade
4/1: Last day to drop class with W grade