

Worcester Polytechnic Institute
 Department of Mathematical Sciences
 Professor: Stephan Sturm
 Teaching Assistant: Weijie Pang

Fall 2014

MA 528 Measure Theoretic Probability Theory

Syllabus

1. Contact & office hours:

Stephan Sturm

Stratton Hall 202C

(Mon, 11:00 - 11:50 a.m.)

Tue, 1:00 - 1:50 p.m.

(Thu, 10:00 - 11:50 a.m.)

and upon request per email

[ssturm@wpi.edu](mailto:ss Sturm@wpi.edu)

(508) 831-59 21

<https://users.wpi.edu/~ssturm/>

Weijie Pang

Stratton Hall 204, Desk 10

Fri, 3:00 - 5:00 p.m.

(Tue, 12:00 - 2:00 p.m.,

Tutoring Center)

and upon request per email

wpang@wpi.edu

2. Lecture:

Tue, 5:30 - 8:20 p.m., Stratton Hall 309

Conference:

Fri, 1:00 - 3:00 p.m., Washburn Shops 323

Note: There will be class on Friday, November 7, 1:00 - 3:50 p.m. in Washburn 323 and conference on Tuesday, November 11, 3:00-5:00 p.m. in Stratton 309.

3. Textbook:

Jean Jacod & Philip Protter, *Probability Essentials*. Springer Universitext,

Springer-Verlag, Berlin. 2nd edition 2004

(free pdf available via Gordon Library)

Other recommended books:

George G. Roussas, *Measure-theoretic Probability*. Academic Press, Amsterdam, Berlin.

2nd edition 2004

Albert N. Shiryaev, *Probability*. Springer-Verlag, Berlin. 2nd edition 1996 (free pdf available via Gordon Library)

David Williams, *Probability with Martingales*. Cambridge Mathematical Textbooks, Cambridge University Press, Cambridge 1991

4. Ressources:

- Homework will be posted on the course site on piazza, <https://piazza.com/wpi/fall2014/ma528/home/>.
- A discussion forum will be hosted on piazza, <https://piazza.com/wpi/fall2014/ma528/home/>. The forum supports different formatting options, and in particular the inclusion of mathematical symbols via L^AT_EX. See <https://piazza.com/help/formatting.html> for the general formatting guidelines and <http://en.wikibooks.org/wiki/LaTeX/Mathematics#Symbols> for a list of commands for specific symbols. While discussions (also about homework) are encouraged, please refrain from giving complete solutions of homework questions. Giving hints is okay, providing a solution is *dishonest* and will be treated as violation of the academic honesty policy, see 11. Instructors will endorse correct student answers and provide only answers if there is no student answer in reasonable time.
- Grades will be posted on myWPI, <https://my.wpi.edu>

5. Course description as per course catalog:

This course is designed to give graduate student's interest in financial mathematics and stochastic analysis the necessary background in measure-theoretic probability and provide rinterested students in analysis and mathematical statistics. Besides classical topics as the axiomatic foundations of probability, conditional probabilities and independence, random variables and their distributions, and limit theorems, this course focuses on concepts crucial for the understanding of stochastic processes and quantitative finance: conditional expectations, filtrations and martingales as well as change of measure techniques and the Radon-Nikodým theorem. A wide range of illustrative examples from a topic chosen by the instructor's discretion (e.g financial mathematics, signal processing, actuarial mathematics) will be presented. Recommended background: Principles of Real Analysis I (MA 3831).

6. Preliminary course outline:

Topic 1: Axioms of probability, conditional probabilities and independence

Topic 2: Discrete random variables and their distributions

Topic 3: Integration with respect to probability measures, expectation and variance

Topic 4: Continuous random variables and their distributions

Topic 5: Jointly distributed random variables and sums of independent random variables

Topic 6: Sequences of random variables, modes of convergence and the weak law of large numbers, central limit theorem

Topic 7: Conditional expectations, filtrations and martingales

7. **Homework:** There will be one homework assignment per week. It will be given out on Tuesday and will be due on next Tuesday at the begin of the class. The problem sets will be posted on <https://piazza.com/wpi/fall2014/ma528/home/>.

Guidelines:

- Late submission policy: Up to two extensions of the deadline will be granted as long as they are requested per email at least 24 hours in advance. All other late homework (when submitted before the corrected homework of the other students are returned) will be graded with a reduction by 50% of the points.
 - The homework submission has not only to contain the result, but carefully developed calculations and proofs that can actually be followed by a reader.
 - Whereas the discussion of homework problems in (small) groups is not only okay but encouraged, the final write-up has to be done individually. Any copying of homework is a violation of the academic honesty policy (see 11.) and will be treated as such.
8. **Quizzes & Exam:** There will be 6 quizzes of 25 minutes will be conducted during the term. Final exam will be a 3h written exam. It will be closed books, a (simple) calculator and a “cheat sheet“ (1 letter-sized, 2-sided paper) will be allowed.

Quizzes

Tuesday, September 16, 5:30 p.m.
 Tuesday, September 30, 5:30 p.m.
 Tuesday, October 14, 5:30 p.m.
 Tuesday, November 4, 5:30 p.m.
 Tuesday, November 18, 5:30 p.m.
 Tuesday, December 9, 5:30 p.m.

Stratton Hall 309

Final Exam

Tuesday, December 16, 5:30 a.m.

Stratton Hall 309

9. **Grading:** The total score will be composed from the individual scores by using the following weighting:

- 10% Problem sets — lowest result will be dropped
- 45% Quizzes — lowest result will be dropped
- 45% Final exam

The achievement of the following total score will be sufficient for the stated letter grades:

- A 85%
- B 75%
- C 60%

10. **Students with disabilities:** If you need course adaptations or accommodations because of a disability, or if you have medical information to share with me that may impact your performance or participation in this course, please make an appointment with me as soon as possible.

If you have approved accommodations, please go to the Exam Proctoring Center (EPC) in Morgan Hall to pick up Letters of Accommodation.

If you have not already done so, students with disabilities who need to utilize accommodations in this class are encouraged to contact the Office of Disability Services (ODS) as soon as possible to ensure that such accommodations are implemented in a timely fashion. This office can be contacted via email: DisabilityServices@wpi.edu, via phone: (508) 831-4908, or in person: 137 Daniels Hall.

11. **Academic honesty:** Each student is expected to familiarize him/herself with WPI's Academic Honesty policies which can be found at <http://www.wpi.edu/offices/policies/honesty>. All acts of fabrication, plagiarism, cheating, and facilitation will be prosecuted according to the university's policy. If you are ever unsure as to whether your intended actions are considered academically honest or not, please contact me.
12. **Independent study** (1 credit): Upon student's request, an independent study designed for PhD students can be scheduled parallel to the class. It will consist of additional problems and reading assignment.