STAT9810: Advanced Probability
Fall Semester, 2016
Time: 10:00-10:50, MWF
Location: MDLBH 211

Instructor: Athanasios Christou Micheas, Ph.D.
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Course Web Site:
• http://www.stat.missouri.edu/~amicheas/stat9810/index.html

Text:
• Probability and Measure, Third Edition, by Patrick Billingsley

The main text will be supplemented as needed. Focus on the notes from class and use this text and others for quick references, extra examples or exercises.

Recommended:
• A modern Approach to Probability Theory, Bert Fristedt and Lawrence Gray, Birkhauser, 1997.
• Measure Theory, Paul R. Halmos, 1950.

Prerequisites: STAT 4750/7750 or MATH 4700/7700 or instructor’s consent.

Topics to be covered:
• Set Theory and Probability Theory
  – Algebras and $\sigma$–Algebras, Borel $\sigma$–Algebras, Subalgebras, Generated $\sigma$–Algebras, Tail $\sigma$–Algebras, Limits of Sets, Set functions
  – Probability Measures and Spaces
  – Extensions: Outer Probability Measures
  – Sierpinski Class Theorem and uniqueness of a Probability Measure
Calculating Probabilities: Borel-Cantelli Lemmas, Kochen-Stone Lemma, Kolmogorov 0-1 Law

• General Measure Theory
  – Definition of a Measure, Absolutely Continuous and Singular Measures
  – Lebesgue Measure and Counting Measure
  – Extensions: Inner and Outer Measures
  – Measurable Sets and functions
  – Product spaces and Product Measure (Finite and Infinite)
  – Lebesgue Decomposition Theorem, Hahn Decomposition, Caratheodory Theorem, Radon-Nikodym Theorem

• Integration Theory
  – Definitions and Uniqueness
  – Properties of Integrals
  – Lebesgue Integration
  – Product Measure and Fubini’s Theorem

• Random Variables
  – Definition of a Random Variable or Vector, Spaces of Random Variables: \( \mathbb{R}^d, \mathbb{R}^\infty, \text{Hilbert} \)
  – Distribution Functions: Glivenko-Cantelli Theorem, Characteristic Functions
  – Conditional Probability and Independence
  – Sequences of Random Variables, Convergence Theorems, Convolutions

• Expectation and Conditional Expectation
  – Definition of Expectation with respect to a measure, Riemann-Stieltjes Integral
  – Conditional Distributions
  – Conditional Expectation as a random variable
  – Martingales and their properties

Homework:

• There will be about seven problem sets assigned during the semester.

• When submitting your homework:
  – Display clearly on the top of the first page: your name(last, first), the course name and section and the assignment number.
  – Homework should be done on standard-size paper (8 1/2" by 11").

• All homework must be turned in at the beginning of class on the due date. The only exceptions are acts of God, illness (doctor’s note expected), or death in the family (provide obit).

Exams:

• There will be one midterm examination and a comprehensive final exam. The dates for the exams are as follows (same room for all, MDLBH 211):
- Midterm: Friday, October 14
- FINAL EXAM: TBA

- Examinations must be taken at the scheduled times. Make-up exams will not be given.
- All exams are closed book. Calculators are allowed to help in numerical calculations.

**Grading:**
- Your grade will be based on a weighted average of your midterm score (30%), homework average (40%), and final exam score (30%).

**Students with disabilities:**
If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, see me privately after class or at my office.

If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please register with the Office of Disability Services (http://disabilityservices.missouri.edu), S5 Memorial Union, 573-882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for persons with disabilities, click on "Disability Resources" on the MU homepage.

**Academic Honesty:**
Academic honesty is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person’s work has been responsibly and honorably acquired, developed and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards academic dishonesty as an extremely serious matter, with serious consequences that range from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, or collaboration, consult the course instructor.

**Intellectual pluralism:**
The University community welcomes intellectual diversity and respects student rights. Students who have questions concerning the quality of instruction in this class may address concerns to either the Departmental Chair or Divisional leader or Director of the Office of Students Rights and Responsibilities (http://osrr.missouri.edu/). All students will have the opportunity to submit an anonymous evaluation of the instructor at the end of the course. An email will be sent to you about how to complete this process during the last few weeks of the semester.

**Cell Phones:**
It is your responsibility as a student of this university, to have your cell phones, ipods, kindles, etc., CLOSED before entering the classroom. If a cell phone rings, you text, or you use electronic devices during a lecture or exam, the instructor has the right to impose disciplinary sanctions, ranging from reduction of your final grade, probation to expulsion from the lectures. Only one warning will be given. Using cell phones in class is not proper university conduct. If you are expecting an important phone call for medical emergencies make sure you inform the instructor before the class/exam begins.