

Course Information

Time: TR 9:10 – 10:25 a.m. (per. 2.8–3) **Location:** 230 FLO (Griffin-Floyd Hall)

Instructor: Dr. Brett Presnell

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Text: Billingsley (1996). *Probability and Measure* (3rd ed). Wiley, New York.

Course Content and Objectives

The two-semester sequence STA 6466–6467 covers material from measure, integration, and probability theory that every statistics doctoral student should know. This includes the fundamentals of measure theory and Lebesgue integration, independence, modes of convergence of random variables, convergence of series of independent random variables, weak and strong laws of large numbers, characteristic functions, the central limit problem, conditional expectation, and the basics of discrete time martingale theory. Other topics will be introduced as time permits.

Grading

There will be a three exams (both in-class and closed-book), each accounting for 25% of the course grade. The first two exams are tentatively scheduled for the weeks of February 13 and March 26. The final will be given on the scheduled exam date (April 29). Homework will be collected regularly throughout the term and will determine the remaining 25% of the course grade.

Prerequisites

Students are assumed to have experience with and a working knowledge of set theory and elementary classical real analysis. Suitable prerequisite courses are MAA 6236, Mathematical Analysis for Statisticians or MAA 5228, Modern Analysis I. Students familiar with most of the topics in a text such as Rudin's *Principles of Mathematical Analysis* (first 7 chapters) should be well prepared to enter this course. Naturally students taking STA 6467 should have had STA 6466 beforehand, or an equivalent course.

Supplementary References

There are many wonderful books on probability theory, though most implicitly or explicitly assume that you already know some measure theory. You may find it useful to consult any in the following list.

1. Athreya, K. B. and Lahiri, S. N. (2006). *Measure Theory and Probability Theory*. Springer, New York. (A new book. I haven't had a chance to read it carefully, but it looks very similar to my notes. I may adopt it as the course text in the future.)
2. Brieman, L. (1968). *Probability*. Addison-Wesley, Reading, Mass. (A classic, now available in a reprint edition from SIAM.)
3. Chung, K. L. (1974). *A Course in Probability Theory* (2nd ed.). Academic Press, New York. (The text I had as a student, also a classic. There is now a second edition.)
4. Dudley, R. M. (1989). *Real Analysis and Probability*. (Originally published by Chapman & Hall, then Wadsworth, then CRC, and now by Cambridge. An excellent book with more of a "topological" emphasis. The paperback version from Cambridge is a bargain.)
5. Durrett, R. (2004). *Probability: Theory and Examples* (3rd ed.). Duxbury Press, Belmont, California. (Many good examples.)
6. Feller, W. (1966). *An Introduction to Probability Theory and Its Applications*, Vol. II. Wiley, New York. (Very "analytical," but has certain things that are hard to find anywhere else.)
7. Fristedt, B. and Gray, L. (1997). *A Modern Approach to Probability Theory*. Birkhäuser, Boston.
8. Karr, A. F. (1993). *Probability*. Springer-Verlag, New York. (More elementary than the rest in this list.)
9. Loeve, M. (1955, 1st ed). *Probability Theory*. Van Nostrand, Princeton, New Jersey. (This is a real classic, and there are many editions. Your (great?) grandfather learned probability from this book.)
10. Pollard, D. (2001). *A User's Guide to Measure Theoretical Probability*. Cambridge University Press. (A new book, written in an interesting and lively style; inexpensive in paperback.)
11. Resnick, S. I. (1999). *A Probability Path*. Birkhäuser, Boston. (Brief and to the point, with lots of good exercises, but it's new, so beware of the occasional misprint or mistake.)
12. Shorack, G. R. (2000). *Probability for Statisticians*. Springer-Verlag, New York. (Interesting new book, but again, beware of misprints and mistakes.)
13. Shiryaev, A. N. (1996, 2nd ed). *Probability*. Springer, New York.

Guidelines for Homework and Exams

(with thanks to Ian McKeague)

0. Your work must be neat and legible, particularly on homework (some latitude will be given on exams because of the time restrictions).
1. Mathematics is prose. Each statement should be a sentence, generally with a subject, object, and verb. End an equation with a punctuation mark if it is at the end of a sentence. An “=” can operate as a verb. Never start a sentence with notation.
2. Don't use unnecessary words—use notation to cut down on tedious repetition.
3. Do your exploratory work on scratch paper and do not turn it in with your final solution. If you are asked to prove something for all finite n , special cases (e.g., $n = 1$, $n = 2$) are considered exploratory, unless they are the beginning of an induction argument.
4. The Good Samaritan Rule: when you need to use a standard result, mention its *name*, and not a theorem number. If the result has no name, then you should state it, at least in outline (and include a proof if it is not a standard result from class or from real analysis). Don't assume the reader knows what you are about to do—it is often helpful to outline the steps of your solution before plunging into details.
5. For exams, start each problem on a separate sheet of paper; write your name at the top right-hand corner of the first sheet.
6. For homework problems, use lined paper and write only on the front side of each page. Do not write in the top left-hand corner of any page (leave about a square inch) so that your work will not be obscured when the pages are stapled together. Answer the problems in the order in which they were assigned. Write out the question before giving the solution. Staple the sheets of paper together.
7. If you introduce some notation which was not specified in the problem, you must define or specify it. A common mistake is to use an ϵ without initially saying “Let $\epsilon > 0$.”
8. Your work will usually be more readable if you use displayed equations rather than embedding long equations in the text.
9. Each step of your solution needs to be justified, either by naming a standard result, or filling in the gap by a separate argument. If you are unable to fill the gap (or to do any part of the problem), say so explicitly so that I will know that you know that you don't know.
10. If you are stuck on a homework problem, ask me for a hint. You have nothing to lose by asking for a hint, but you will lose points for incomplete work.
11. You are free to discuss homework problems among yourselves, but your solution must reflect your own work. Don't copy: your solution should reflect your own understanding of the problem, not that of someone else. And don't rely on others to solve the problems for you: you will only learn to solve problems by hard practice, and that means solving the problems on your own.