

STA 711: Course Information

Probability & Measure Theory

Duke University, Fall 2021

Overview: This is a course about random variables, especially about their convergence and conditional expectations, motivating an introduction to the foundations of modern Bayesian statistical inference.

Prerequisites: Students are expected to be well-versed in real analysis at the level of W. Rudin's *Principles of Mathematical Analysis* or M. Reed's *Fundamental Ideas of Analysis*. Specific topics include the topology of \mathbb{R}^n , convergence in metric spaces (especially uniform convergence of functions on \mathbb{R}^n), infinite series, countable and uncountable sets, compactness and convexity. More advanced mathematical topics from real analysis, including parts of measure theory, Fourier and functional analysis, are introduced as needed to support a deep understanding of probability and its applications.

Logistics:

Instructor: Galen Reeves

Textbook: *A Probability Path*, Sidney Resnick, Springer 2014

Grading:	20%	Homework (10 assignments, lowest grade dropped)
	20%	First midterm exam
	20%	Second midterm exam
	40%	Final Exam

Syllabus: Topics include:

- Probability spaces: Sets, Events, and σ -Fields
- Construction & extension of Measures
- Random variables and their Distributions
- Expectation & the Lebesgue Theorems
- Expectation Inequalities, L_p Spaces, & Independence
- Zero-one Laws & Hoeffding's Inequality
- Convergence
- Laws of large numbers
- Fourier Theory and the Central Limit Theorem
- Conditional Expectations & the Radon-Nikodym theorem
- Introduction to Martingales