

# IERG 6300: THEORY OF PROBABILITY

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ABSTRACT. This class covers basics of probability theory from a measure theoretic perspective.

LOCATION: SHB 833

HOURS: Mon 12:30 - 2:15, Thu 1:30 - 3:15

## 1. COURSE OUTLINE

- i) Measure-theoretic foundations of probability theory
  - Construction of measures
  - Random variables, distributions, integration
- ii) Weak convergence
  - Characteristic functions
  - Weak Convergence
- iii) Independent sums - limit theorems
  - Weak Law of large numbers
  - Strong law of large numbers
  - Central limit theorem
  - Concentration inequalities
- iv) Dependent random variables
  - Conditional expectation
  - Markov chains
  - Stopping times
- v) Martingales
  - Martingale convergence theorem
  - Doob's decomposition theorem and up-crossing inequality
- vi) Ergodic Theory
  - Sub-additive ergodic theorem

## 2. TEXTBOOK AND OTHER REFERENCES

- a) Class notes (mainly based on the text below)
- b) **Main Text:** Probability Theory (Courant Lecture Notes) by S.R.S. Varadhan
  - Available at [Amazon](#)
  - Remarks:** The textbook is rather terse if you have not encountered the results before. However I like the presentation of the contents very much and I will fill the "left-out" arguments in class. Sometimes I will deviate from the presentation in this book and use alternate proofs, especially for the strong law of large numbers where I will be following Etemadi's proof.

- I have also found an earlier version of the book online from Varadhan's website (Google search).
- c) Probability Theory and Examples, Durrett. [Amazon](#)
- d) List of references from David Aldous's [course website](#).

### 3. GRADING POLICY AND REMARKS

- This is a class where the subject matter is best learnt by working through homeworks and arguments. Hence there will be regular homeworks.
  - Homeworks 30%
  - Mid-term (3-day take home) 30%
  - Final (1 week take home) 40%
- The focus will be on mathematical rigor and proofs.
- **Pre-requisites:** A (graduate-level) course on real analysis would be ideal. However, if one is mathematically inclined, then an exposure to analysis arguments at the undergraduate level would be sufficient.