

GCE Syllabus - Probability

Related course: MA540 - Probability and Mathematical Statistics I.

Reference textbook:

Statistical Inference (2nd Edition) by Casella and Berger. Chapters 1-5.

Expected skills:

- Understanding the foundation of probability: basic concepts, theorems, their connections as well as the fundamental ideas behind definitions and theorems.
- Abilities of thinking, arguing, and deducing; proving classic theorems and propositions.
- Abilities of reasoning and applying theorems and calculations to address probabilities related problems connected to reality.

Topics: The questions of the exam will be related to some of the following topics:

1. Probability Theory: (a) Basic Set Theory; (b) Axiomatic foundations, calculus, counting and enumerating related to probabilities; (c) Conditional probability and independence; (d) Random variables, density and distribution functions of random variables.
2. Transformations and Expectations: (a) The expectation operator; (b) Moments and Moment generating function; (c) Transformations, Jacobians, distributions of functions of random variable.
3. Common Families of Distributions: (a) Discrete distributions; (b) Continuous distributions; (c) Exponential families and location-scale families. (d) Probability inequalities.
4. Multiple Random Variables: (a) Joint and marginal distributions; (b) Conditional distributions and independence; (c) Bivariate Transformations; (d) Mixture distributions and hierarchical models; (e) Multivariate distributions; (f) Numerical and functional inequalities.
5. Properties of a Random Sample: (a) Distributions of sums of random variables, and order Statistics; (b) Properties and distributions related to sampling from normal distribution; (c) Convergences in probability and in distribution, almost sure convergence, Laws of Large Numbers, Central Limit Theorems, the delta method; (d) Generating a random sample.

Exam setting: 3 hours, closed book.

Questions and Passing Grade: Usually 6 questions (each may include 2 or more parts).

Note: In order to pass this exam, you must demonstrate sufficient understanding of the underlying definitions, concepts, and methods. Please keep in mind that this is possible without completely solving the problems, but serious mistakes are considered strong evidence of insufficient understanding.

This syllabus has been adopted by the Department of Mathematical Sciences on 12/08/2020 and is overseen by the Graduate Program Committee.