MATH 301 Introduction to Probability Theory

Fall 2025

Credit: (3-0) 3

Catalog description:

Sample spaces and probabilities. Conditional probability. Random variables, their distribution functions, expectation and variance. Normal approximation. Poisson approximation. Moment generating functions. Joint distribution of random variables. Covariance and correlation. Tail bounds. Law of large numbers. Central limit theorem.

Course Objectives:

This course is a calculus based introductory course on probability theory. The emphasis is on the main concepts, calculations and applications, rather than the measure theoretical foundations. Therefore, measure theoretical issues are only mentioned in passing. Sketches of the main theorems such as the law of large numbers and the central limit theorem are given, assuming preparatory results from analysis without proof. The course provides students with essential basic knowledge in probability theory, hence preparing them for various real-world applications or more advanced courses.

Course Learning Outcomes:

At the end of this course a student will

- understand main definitions of probability theory at a working level,
- learn how to compute expectations, variance and higher moments,
- calculate marginal distributions from joint distributions,
- apply normal and Poisson approximation in real life situations,
- make deductions by using the Law of Large Numbers and Central Limit Theorem

Course Instructor:

Yıldıray Ozan (Office: 217, Mathematics Department. Phone: (312) 210 5373)
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Course Website:

https://metuclass.metu.edu.tr/

Textbooks:

- "Introduction to Probability", Anderson, D. F., Seppalainen, T., Valko, B.

Additional Resources:

- "A First Course in Probability", Ross, S. M.

Attendance:

70% attendance is mandatory in order to enter the final exam and to obtain a passing grade.

Exams and Grading:

The grading will be based on two midterm examinations, one final examination and class participation. The class participation grade will be an integer grade from 0 to 10 based on attendance, homework, quizzes, contribution to class activity and scholarly attitude in general.

- Midterm 1: 30% (Thursday, November 6, 2025 at 17:40)
- Midterm 2: 30% (Thursday, December 4, 2025 at 17:40)
- Final: 40% (date to be announced)
- Class participation: 10% (Bonus)

NA Policy:

A student who fails to meet the 70% attendance condition or misses all exams will receive a grade of NA for the course.

Make-up Policy:

In order to be eligible to enter a make-up examination for a missed examination, a student should have a documented or verifiable, and officially acceptable excuse. A student cannot get make-up examinations for two missed exams. The make-up examination for all exams will be after the final exam and will include all topics.

Lectures:

Section, Instructor	Lecture Time (Classroom)
S1. Yıldıray Ozan	Mon. 13:40-14:30 (M-105), Wed. 13:40-15:30 (M-104)

Office Hours:

Tue. and Wed. 15:40-16:30. Also by appointment.

Important Dates:

- **September 29:** Classes begin
- **October 6-10:** Add-drop and advisor approvals
- **October 29:** Republic Day (Wednesday)
- **November 10:** Commemoration of Atatürk (Monday)
- **December 1-7:** Course withdrawal applications
- **January 1:** New Year's Day (Thursday)
- **January 4:** Last day of classes
- **January 5-17:** Final exam period
- **January 26:** The announcement of letter grades

Course Schedule:

The table below is a rough guideline for the content of course lectures. The lectures may be reordered or reorganized if necessary.

Week 1: Sep.29-Oct.3	1. Experiments with random outcomes 1.1 Sample spaces and probabilities 1.2 Random sampling 1.3 Infinitely many outcomes
Week 2: Oct.6-10	1.4 Consequences of the rules of probability 1.5 Random variables: a first look 2. Conditional probability and independence 2.1 Conditional probability
Week 3: Oct.13-17	2.2 Bayes' formula 2.3 Independence 2.4 Independent trials
Week 4: Oct.20-24	2.5 Further topics on sampling and independence 3. Random variables 3.1 Probability distributions of random variables
Week 5: Oct.27-31	3.2 Cumulative distribution function 3.3 Expectation 3.4 Variance
Week 6: Nov.3-7	3.5 Gaussian distribution 4. Approximations of the binomial distribution 4.1 Normal approximation 4.2 Law of large numbers
Week 7: Nov.10-14	4.3 Applications of the normal approximation 4.4 Poisson approximation 4.5 Exponential distribution
Week 8: Nov.17-21	5. Transforms and transformations 5.1 Moment generating function 5.2 Distribution of a function of a random variable
Week 9: Nov.24-28	6. Joint distribution of random variables 6.1 Joint distribution of discrete random variables 6.2 Jointly continuous random variables
Week 10: Dec.1-5	6.3 Joint distributions and independence 7. Sums and symmetry 7.1 Sums of independent random variables
Week 11: Dec.8-12	7.2 Exchangeable random variables 8. Expectation and variance in the multivariate setting 8.1 Linearity of expectation 8.2 Expectation and independence
Week 12: Dec.15-19	8.3 Sums and moment generating functions 8.4 Covariance and correlation
Week 13: Dec.22-26	9. Tail bounds and limit theorems 9.1 Estimating tail probabilities 9.2 Law of large numbers
Week 14: Dec.29-Jan.2	9.3 Central limit theorem 9.4 Monte Carlo method