

MATH 345: Multivariate Distributions

Spring 2023 Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: Topics include discrete and continuous multivariate distributions and their moments, multivariate distributions including multivariate normal and multinomial distributions, order statistics, conditional probability and the use of conditioning, discrete time Markov chains and their examples, discrete time branching processes, homogeneous and nonhomogeneous Poisson processes.

Number of Credits: 3

Prerequisites: MATH 244 with a grade of C or better or MATH 333 with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 345-002	Professor J. M. Loh

Office Hours for All Math Instructors: [Spring 2023 Office Hours and Emails](#)

Required Textbook:

Title	<i>A First Course in Probability</i>
Author	Sheldon Ross
Edition	9th
Publisher	Pearson
ISBN #	978-0321794772
Website	Canvas

University-wide Withdrawal Date: The last day to withdraw with a W is **Monday, April 3, 2023**. It will be strictly enforced.

COURSE GOALS

Course Objectives

Discrete and continuous multivariate distributions and their moments, multivariate distributions including multivariate normal and multinomial distributions, order statistics, conditional probability and the use of conditioning, discrete time Markov chains and their examples, discrete time branching processes, homogeneous and nonhomogeneous Poisson processes.

Course Outcomes *Students are able to:*

- Do problem solving on the topics.
- Analyze discrete and continuous multivariate distributions.
- Use Markov chains.
- Use homogeneous and nonhomogeneous Poisson processes
- Use branching processes.
- Read multivariate distribution journal publications for concepts.
- Gain ideas to do statistical computations.

Course Assessment: Understand topics at the level at which one is able to apply the methods to do problem solving.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the [Department of Mathematical Sciences Course Policies](#), in addition to official [university-wide policies](#). DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Homework/Quizzes	20%
Two Term Exams	45%
Final Exam	35%

Course Policies: It is required that the student read the textbook for the material already covered in class by the instructor and confirm that the basic solved problems are understood and practice solving textbook problems. More explicitly, students must work on the examples and exercises and problems from the textbook on the topics already covered in class, and learn to solve them correctly (please see class participation). The student should compare his or her answers with those given at the end of the textbook or by the instructor. Instructor holds the right to modify in class exams, homework, quizzes dates in the best interest of the class. Instructor uses NJIT student emails or emails provided by students to NJIT as official emails, to make official announcements.

Class Participation: Class attendance is required, and students are encouraged to contribute to class discussion. Participation is the key to a lively class. T Class participation provides the opportunity to practice speaking and persuasive skills, as well as the ability to listen. Comments that are vague, repetitive, unrelated to the current topic, disrespectful of others, or without sufficient foundation receive negative evaluation.

Calculator: No calculators allowed with graphic display/storage capabilities. Exams allow only simple scientific calculators.

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the **Math Department's Attendance Policy**. This policy will be strictly enforced. NOTE: Tardiness to class counts as a half absence (please see class participation above).

Instructors will maintain a detailed record of your attendance, as the administrators need to know the dates you missed classes.

Homework: Homework is generally due within a week unless announced otherwise. Homework assignments will be submitted in class. Late homeworks receive an automatic 20% penalty. No homeworks will be accepted beyond 3 days of the due date.

Exams: There will be two exams during the semester and a comprehensive final exam.

Exams	TBA
Final Exam Period	May 5 - May 11, 2023

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the **Math Department's Examination Policy**. This policy will be strictly enforced.

Makeup Exam Policy: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

Cellular Phones: No cell phones communications (e.g. texting, etc.) during lectures/exams. Please switch off all cellular phones (unless one is using them for learning the current topic) and beepers must be during all class times.

No eating allowed in class.

Wandering: Do not wander in and out of the classroom.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: **Spring 2023 Hours**)

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for **Instructor Office Hours and Emails**.

Accommodation of Disabilities: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Scott Janz, Associate Director of Disability Support Services at **973-596-5417** or via email at **scott.p.janz@njit.edu**. The office is located in

Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website at:

<https://www.njit.edu/accessibility/>

Important Dates (See: [Spring 2023 Academic Calendar](#), [Registrar](#))

Date	Day	Event
January 17, 2023	Tuesday	First Day of Classes
January 23, 2023	Monday	Last Day to Add/Drop Classes
March 13, 2023	Monday	Spring Recess Begins
March 18, 2023	Saturday	Spring Recess Ends
April 3, 2023	Monday	Last Day to Withdraw
April 7, 2023	Friday	Good Friday - No Classes
May 2, 2023	Tuesday	Friday Classes Meet
May 2, 2023	Tuesday	Last Day of Classes
May 3 - May 4, 2023	Wednesday and Thursday	Reading Days
May 5 - May 11, 2023	Friday to Thursday	Final Exam Period

Course Outline

Week	Chapter	Topic
1	1-5	Review of probability
2	6.1-6.3	Joint distributions, Independence; Sums of independent random variables
3	6.3	Sums of independent random variables
4	6.4-6.5	Conditional distributions
5	6.6	Order statistics; review for exam
6	6.6	Exam 1; Order statistics
7	6.7-6.8	Functions of random variables; Exchangeable random variables
8	7.1-7.3	Expectation of sums of random variables; Moments

9	7.4-7.5	Covariance, variance of sums and correlations; Conditional expectation
10	7.6	Exam 2; Conditional expectation and prediction
11	7.7-7.8	Moment generating functions; multivariate normal distribution
12	8.1-8.4	Limit Theorems; Chebyshev's, CLT, strong law of large numbers
13	8.5-9.1	Other inequalities; Poisson Processes
14	9.1-9.2	Poisson Processes; Markov chains
15		Review
16		Final Exam

*Updated by Professor J. M. Loh - 1/4/2023
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