

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 345: Multivariate Distributions Spring 2025 Course Syllabus

NJIT Academic Integrity Code: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity Code.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

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, homogenous 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 K. Wicke |

Office Hours for All Math Instructors: Spring 2025 Office Hours and Emails

Required Textbook:

| Title | A First Course in Probability |
|-----------|-------------------------------|
| Author | Sheldon Ross |
| Edition | 10th |
| Publisher | Pearson |

| ISBN # | ISBN-13: 9780138076719 (Text) ISBN-13: 9780137504589 (eText) |
|---------|---|
| Website | Canvas |

University-wide Withdrawal Date: The last day to withdraw with a W is Monday, April 7, 2025. It will be strictly enforced.

COURSE GOALS

Course Objectives:

- Knowledge of discrete and continuous multivariate distributions and their moments, including the multivariate normal and multinomial distributions.
- Familiarity with order statistics and their properties.
- Understanding of conditional probability and the use of conditioning.
- Knowledge of basic stochastic processes, including discrete time Markov chains and homogenous/nonhomogeneous Poisson processes.

Course Outcomes: On successful completion students will

- have a solid understanding of central concepts and ideas underlying multivariate distributions and basic stochastic processes.
- use Markov chains and homogenous/nonhomogeneous Poisson processes;
- be able to solve introductory level and more challenging problems that involve multivariate distributions;
- be experienced in writing and presenting probabilistic arguments involving multivariate distributions and basic stochastic processes;
- be prepared for more advanced probability theory and statistics courses.

Course Assessment: Will be based on weekly homework and quizzes, two midterm exams, and one (comprehensive/cumulative) final exam.

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 | 15% |
|-----------------|-----|
| Quizzes | 15% |
| Midterm Exam I | 20% |
| Midterm Exam II | 20% |
| Final Exam | 30% |

Homework will be marked out of 10 points each and quizzes will be marked out of 5 points each (in both cases, the

lowest score will be dropped), while exams will be marked out of 100 points; all scores will be converted into percentages.

Your final letter grade will be based on the following tentative curve.

| А | 90-100 | с | 68-74 |
|----|--------|---|-------|
| В+ | 85-89 | D | 50-67 |
| В | 80-84 | F | 0-49 |
| C+ | 75-79 | | |

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

Religious Observance: NJIT is committed to supporting students observing religious holidays. Students must notify their instructors in writing of any conflicts between course requirements and religious observances, ideally by the end of the second week of classes and no later than two weeks before the anticipated absence.

Homework: Homework assignments will be posted on Canvas and will usually be due at 11:59pm on Tuesdays unless announced otherwise. No late homework will be accepted. You are encouraged to work together on the homework, but do not copy any part of the homework or look up/request solutions to homework problems in online forums or websites. Each student must submit their own homework to be submitted online as a PDF file through Canvas. Feel free to ask me for help during my office hours after you have made an attempt at the question. I will also provide homework solutions that are detailed enough to allow you to understand how the question could be approached.

Homework assignments may contain both graded and ungraded parts and only the graded problems will need to be submitted. However, you should always make an attempt at the ungraded problems as well. For submission, put your name and the homework assignment number on the top right corner of every page and submit the problems in order. The purpose of written homework is to assess and provide feedback on your understanding of and ability to explain the reasoning behind complex derivations, graph algorithms, or proofs. Therefore, answers with little or no explanation or work shown will receive no credit. **The lowest homework score will be dropped at the end of the semester.**

Quizzes: There will be a weekly online quiz on Fridays when there is no midterm exam or holiday (except for the first and last week of the semester). The quizzes will contain similar but not identical problems as the homework assignment due that week. It thus makes sense to revise the content of the homework due on Tuesday before taking the quiz on Friday. All quizzes will be administered through Canvas, and you will have a 24-hour window to start the quiz. Once the quiz is started it will need to be completed within a set time window of 15-25 minutes (depending on the complexity of the problems). The lowest quiz score will be dropped at the end of the semester.

Exams: There will be two midterm exams and one final exam. The midterm exam dates are tentative and may be subject to change.

| Midterm Exam I | Feb 28, 2025 |
|----------------|--------------|
| | |

| Midterm Exam II | Apr 11, 2025 |
|-------------------|-----------------------|
| Final Exam Period | May 10 - May 16, 2025 |

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.

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

Cellular Phones : All cellular phones and other electronic devices must be switched off during all class times unless being used for in-class work.

Al Usage: This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, AI usage is not permitted throughout this course under any circumstance.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2025 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 If you need an accommodation due to a disability please contact the Office of Accessibility Resources and Services at oars@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services at oars@njit.edu.

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 2025 Academic Calendar, Registrar)

| Date | Day | Event |
|------------------|---------|------------------------------|
| January 21, 2025 | Tuesday | First Day of Classes |
| January 27, 2025 | Monday | Last Day to Add/Drop Classes |

| March 16, 2025 | Sunday | Spring Recess Begins |
|-----------------------|--------------------|---|
| March 22, 2025 | Saturday | Spring Recess Ends |
| April 3, 2025 | Thursday | Wellness day |
| April 7, 2025 | Monday | Last Day to Withdraw |
| April 18, 2025 | Friday | Good Friday - No Classes |
| April 20, 2025 | Sunday | Easter Sunday - No Classes Scheduled |
| May 6, 2025 | Tuesday | Thursday Classes Meet |
| May 7, 2025 | Wednesday | Friday Classes Meet |
| May 7, 2025 | Wednesday | Last Day of Classes |
| May 8, 2025 | Thursday | Reading Day 1 |
| May 9, 2025 | Friday | Reading Day 2 |
| May 10 - May 16, 2025 | Friday to Thursday | Final Exam Period |

Course Outline (tentative)

| Week | Dates | Topic (sections in textbook, roughly) |
|------|------------|--|
| 1 | Jan 21, 24 | Review of Probability (Ch. 1-3) |
| 2 | Jan 28, 31 | Review of Probability (Ch. 4-5) |
| | | Quiz 1 on Jan 31 |
| 3 | Feb 4, 7 | Joint Distribution Functions (6.1) |
| | | Independent Random Variables (6.2) |
| | | Quiz 2 on Feb 7 |
| 4 | Feb 11, 14 | Sums of Independent Random Variables (6.3) |
| | | Conditional Distributions: Discrete Case (6.4) |
| | | Quiz 3 on Feb 14 |

| 5 | Feb 18, 21 | Conditional Distributions: Continuous Case (6.5) |
|----|--------------------|---|
| | | Order Statistics (6.6) |
| | | Quiz 4 on Feb 21 |
| 6 | Feb 25, 28 | Review for Midterm Exam I |
| | | Midterm Exam I on Feb 28 |
| 7 | Mar 4, 7 | Joint Probability Distributions of Functions of Random Variables (6.7) |
| | | Exchangeable Random Variables (6.8) |
| | | Quiz 5 on Mar 7 |
| 8 | Mar 11, 14 | Expectation of Sums of Random Variables (7.1, 7.2) |
| | | Moments of the Number of Events that Occur (7.3) |
| | | Quiz 6 on Mar 14 |
| 9 | Mar 25, 28 | Covariance, Variance of Sums, and Correlations (7.4) |
| | | Conditional Expectation (7.5, 7.6) |
| | | Quiz 7 on Mar 28 |
| 10 | Apr 1, 4 | Moment Generating Functions (7.7) |
| | | Multivariate Normal Distribution (7.8) |
| | | Quiz 8 on Apr 4 |
| 11 | Apr 8, 11 | Review for Midterm Exam II |
| | | Midterm Exam II on Apr 11 |
| 12 | Apr 15, 18 | Introduction to Limit Theorems, Chebyshev's Inequality, the Weak Law of |
| | no class on Apr 18 | Large Numbers, and the Central Limit Theorem (8.1 - 8.3) |
| 13 | Apr 22, 25 | CLT cont. and the Strong Law of Large Numbers (8.3, 8.4) |
| | | Other Inequalities (8.5) |
| | | Quiz 9 on Apr 25 |
| 14 | Apr 29, May 2 | Poisson Process (9.1) |
| | | Markov Chains (9.2) |
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| | | Quiz 10 on May 2 |
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| 15 | May 7 | Final Review |

Updated by Professor K. Wicke - 2025 Department of Mathematical Sciences Course Syllabus, Spring 2025