

Fall 2023

## MATH 244-001, Fall 2023: Introduction to Probability Theory

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## MATH 244: Introduction to Probability Theory

### *Fall 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 basic probability theory in discrete and continuous sample space, conditional probability and independence, Bayes' theorem and event trees, random variables and their distributions, joint distribution and notion of dependence, expected values and variance, moment generating functions, useful parametric families of distributions including binomial, geometric, hypergeometric, negative binomial, exponential, gamma, normal and their applications, simple case of central limit theorem and its uses.

**Number of credits:** 3

**Prerequisites:** MATH 112 with a grade of C or better.

**Course-Section and Instructors:**

Course-Section	Instructor
Math 244-001	Professor K. Wicke

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

**Required Textbook:**

Title	<i>Probability</i>
Author	Jim Pitman
Edition	1st
Publisher	Springer
ISBN #	9780387979748

**University-wide Withdrawal Date:** The last day to withdraw with a **W** is **Monday, November 13, 2023**. It will be strictly enforced.

## COURSE GOALS

### Course Objectives:

- Understand the basic principles of probability including laws for unions, intersections, and complements, as well as Bayes' theorem, and use them to calculate probabilities.
- Understand the definitions of discrete and continuous random variables and their distributions (including joint, marginal, and conditional distributions), compute expectation, variance, covariance, and correlation of random variables, know the definitions of density and distribution functions of random variables, and be able to compute them.
- Learn about uniform, binomial, multinomial, geometric, hypergeometric, Poisson, negative binomial, normal, exponential, and gamma random variables, know their distributions and parameters, and understand when to use them.
- Become familiar with moment generating functions, transformation techniques, and basic limit theorems in probability, including the law of large numbers and the central limit theorem.

### Course Outcomes: On successful completion students will

- have a greater understanding of central concepts and ideas in probability, in particular random variables and their distributions, and have learnt how to interpret probabilistic statements;
- be able to solve introductory level and more challenging problems that involve randomness and chance;
- be prepared for more advanced mathematics 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.

A	90 - 100	C	68 - 74
B+	85 - 89	D	50 - 67
B	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.

**Homework:** Homework assignments will be posted on the **class website** and will usually be due at 11:59pm on Mondays 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 the **class website**. 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 will 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 or probabilistic arguments. 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 Thursdays when there is no midterm exam or holiday (except for the first two 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 Monday before taking the quiz on Thursday. All quizzes will be administered through the **class website**, 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	October 12, 2023
Midterm Exam II	November 16, 2023
Final Exam Period	December 17 - December 23, 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:** All cellular phones and other electronic devices must be switched off during all class times.

## ADDITIONAL RESOURCES

**Math Tutoring Center:** Located in the Central King Building, Lower Level, Rm. G11 (See: [Fall 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 need an accommodation due to a disability, please contact the Office of Accessibility Resources and Services at [oars@njit.edu](mailto:oars@njit.edu), or visit Kupfrian Hall 201 to discuss your specific needs. A Letter of Accommodation Eligibility from the office authorizing student accommodations is 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: [Fall 2023 Academic Calendar, Registrar](#))

Date	Day	Event
September 4, 2023	Monday	Labor Day
September 5, 2023	Tuesday	First Day of Classes
September 11, 2023	Monday	Last Day to Add/Drop Classes
November 13, 2023	Monday	Last Day to Withdraw
November 21, 2023	Tuesday	Thursday Classes Meet
November 22, 2023	Wednesday	Friday Classes Meet
November 23 to November 26, 2023	Thursday and Saturday	Thanksgiving Recess - Closed
December 13, 2023	Wednesday	Last Day of Classes
December 14, 2023	Thursday	Reading Day 1
December 15, 2023	Friday	Reading Day 2
December 17 to December 23, 2023	Sunday to Saturday	Final Exam Period

## Course Outline (tentative)

Week	Dates	Topic (sections in textbook, roughly)
1	Sep 7 <small>(asynchronously online)</small>	Introduction and course overview
2	Sep 11, 14	Basic concepts in probability (1.1, 1.2) Rules of probabilities and first examples of distributions (1.3)
3	Sep 18, 21	Conditional probability (1.4) Independence and Bayes' Rule (1.4, 1.5)  <b>Quiz 1 on Sep 21</b>
4	Sep 25, 28	Multiplication rule, tree diagrams, and sequences of events (1.6) Binomial distribution (2.1)  <b>Quiz 2 on Sep 28</b>
5	Oct 2, 5	Normal distribution and normal approximation (2.2) Poisson distribution and Poisson approximation (2.4)  <b>Quiz 3 on Oct 4</b>
6	Oct 9, 12	Review  <b>Midterm Exam I on Oct 12</b>
7	Oct 16, 19	Discrete random variables, probability mass functions, and discrete distributions (3.1) Expectation, indicators, and Markov's inequality (3.2)  <b>Quiz 4 on Oct 19</b>
8	Oct 23, 26	Expectation, indicators, and Markov's inequality continued (3.2) Variance, standard deviation, Chebychev's inequality, and the Central Limit Theorem (3.3)  <b>Quiz 5 on Oct 26</b>
9	Oct 30, Nov 2	More discrete distributions: geometric and negative binomial (3.4, 3.5)

		<p>Continuous random variables and probability densities (4.1)</p> <p><b>Quiz 6 on Nov 2</b></p>
10	Nov 6, 9	<p>Examples of continuous distributions: uniform, normal, exponential, and gamma (4.1, 4.2)</p> <p>Cumulative distribution functions, the CDF technique, and transformations (4.4, 4.5)</p> <p><b>Quiz 7 on Nov 9</b></p>
11	Nov 13, 16	<p>Review</p> <p><b>Midterm Exam II on Nov 16</b></p>
12	Nov 20, 21	<p>Cumulative distribution functions, the CDF technique, and transformations continued (4.4, 4.5)</p> <p>Moment generating functions (supplemental material)</p>
13	Nov 27, 30	<p>Uniform distributions over planes and volumes (5.1)</p> <p>Conditional distribution/expectation: Discrete case (6.1, 6.2)</p> <p><b>Quiz 8 on Nov 30</b></p>
14	Dec 4, 7	<p>Covariance and correlation (6.4)</p> <p><b>Quiz 9 on Dec 7</b></p>
15	Dec 11	<p>Final Review</p>

*Updated by Professor K. Wicke - 8/11/2023*  
*Department of Mathematical Sciences Course Syllabus, Fall 2023*