RUTGERS UNIVERSITY COURSE SYLLABUS

Fall 2022

DEPARTMENT:	**Mathematics**
COURSE TITLE:	**Mathematical Theory of Probability**
COURSE NUMBER:	**MATH 477 Sec 02**
PREREQUISITE:	**MATH 251**
INSTRUCTOR:	**Joshua Salamon, e-mail: joshua.salamon@rutgers.edu** **Office hours (subject to change) please make appointment:** **Tuesday 1:45 - 2:30 pm Hill 428, Thursday: 8:00 – 8:40 online** **or other times by appointment**
ASSISTANT (TA)	**Michael Doppelt, e-mail: mad488@math.rutgers.edu** **Office Hours: TBA**
LECTURE TIMES:	**Tuesday, Friday 12:10pm – 1:30 am, COR Room 101**
CREDIT HOURS:	**3**

COURSE DESCRIPTION

This course provides a thorough grounding in probability and its mathematical foundation. Discrete and continuous probability distributions and their moment generating functions will be covered. Integration (including techniques from multivariate calculus) will be employed for continuous distributions.

COURSE OBJECTIVES

The student should be able to explain concepts and solve problems in classical and modern probability. This course caters to a wide variety of interests. Students pursuing the actuarial profession will find this course helpful (with significant additional self-study) in preparation for exam P by the Society of Actuaries.

COURSE TEXTBOOK

A first course in Probability – Tenth Edition, Sheldon Ross

COURSE CONTENT (chapters follow the course textbook)

Week 1 Chapter 1 – Course intro, Combinatorial Analysis: Multiplication principle, Permutations, Combinations, Binomial Theorem, Partitions.

Week 2 Chapter 2 – Fundamental principles and concepts of set theory: Unions, Intersections, Venn diagrams De Morgan's laws. The Axioms of Probability. Basic Probability concepts: Outcomes, Events, Sample space, Calculating Probability where outcomes are equally likely

Week 3 Chapter 3 – Conditional Probability and Bayes' Theorem. (Optional: The Monte Hall problem)

Week 4 Chapter 3 – Independent events, mutually exclusive events
Chapter 4 – Function based definition of Random Variable

Week 5 Midterm Exam 1. Chapter 4 - Discrete random variables: Distributions, Expectation, Variance. Transformation (function) of random variables

Week 6 Chapter 4 – Families of discrete probability distributions: Bernoulli, Binomial, Poisson. Geometric, Negative binomial, Hyper-Geometric. Expected value of sums of random variables

Week 7 Chapter 5 – Continuous random variables: Density, Cumulative distribution, Expectation, Variance, Transformation of a random variable

Week 8 Chapter 5 – Families of continuous probability distributions: Uniform, Exponential, Normal, Lognormal, Gamma

Week 9 Chapter 5 – The density function of a transformed random variable
Chapter 6 – Jointly distributed random variables: Marginal distribution, Independence

Week 10 Midterm Exam 2 Chapter 6 – Jointly distributed random variables: Conditional distributions

Week 11 Chapter 7 – Covariance, Variance of a linear combination of random variables (the variance covariance formula), Correlation

Week 12 Chapter 7 – Conditional expectation and variance of jointly distributed random variables. Using conditional expectation and variance to obtain the overall expectation and variance

Week 13 Chapter 7 – Moments of distributions and their uses. The Moment Generating Function and its properties

Week 14 Chapter 8 – Markov and Chebyshev inequalities, weak law of large numbers,
The Central Limit Theorem (and its proof – time permitting)

FINAL EXAMINATION EXPECTED DATE AND TIME

Friday December 23, 12:00 pm

COURSE REQUIREMENTS

- **2 Midterm Examinations**
- **Final Examination**
- **Homework Assignments**

GRADING GUIDELINES

The final grade will be based on the total number of points you accumulate throughout the course. Homework assignments: 15%, Midterm 1: 20%, Midterm 2: 25% Final exam: 40%.

ATTENDANCE AND CLASS PARTICIPATION

Although attendance will not be taken, students are expected to attend all classes. Information not found in the textbook may be given in class and tested in the exams. Active class participation is welcomed in my lectures and may be considered favorably when determining a borderline grade.

If you miss an exam, the grade for that exam will be 0 unless you have a compelling and documented reason accepted in advance (when possible) by the professor.

ACEDEMIC INTEGRITY

Students are expected to uphold all university policies with regard to ethics and academic integrity in this course. http://academicintegrity.rutgers.edu/academic-integrity-policy Any student found or suspected of cheating will be promptly reported to his or her academic dean for immediate disciplinary action *which may include an automatic failing grade in the course and/or expulsion from the university*..

STUDENT WELLNESS SERVICES

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901 /
www.health.rutgers.edu/

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professionals within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

Violence Prevention & Victim Assistance (VPVA)

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / www.vpva.rutgers.edu/

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Disability Services

(848) 202-3111 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / https://ods.rutgers.edu/

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/getting-registered.