University of Massachusetts Global A private nonprofit affiliate

Course Number, Title and Credits

MATU 202 - Introduction to Probability - 3 credits

Course Description

This course introduces the language and core concepts of probability theory. Topics covered include probability spaces, random variables, independence, conditional expectation and probability, joint distributions, consequences, the Central Limit Theorem, and conditional distribution.

Prerequisites: MATU 116 Calculus II or equivalent

Course Learning Outcomes

By the end of this course, students should be able to:

1. Understand and apply the fundamental concepts of probability, including probability spaces, random variables, and independence.
2. Calculate and interpret probabilities, expectations, and variances for both discrete and continuous random variables.
3. Analyze relationships between multiple random variables using joint distributions, covariance, and correlation.
4. Apply key theorems such as the Law of Large Numbers and the Central Limit Theorem to real-world and simulated scenarios.
5. Use conditional probability and expectation to solve problems involving dependent events and conditional distributions.

Required Textbooks

- *Probability and Simulation*, Giray Ökten, Springer Undergraduate Texts in Mathematics and Technology, Springer, 2020. Softcover ISBN: 978-3-030-56069-0. E-book ISBN: 978-3-030-56070-6

- *Introduction to Probability*, David F. Anderson, Timo Seppäläinen, and Benedek Valkó; ISBN: 978110841585

Letter Grade/Percentage Equivalents

Grades are determined on a straight-scale basis using the following scales.

A	94%-100%	A-	90%-93%	B+	87%-89%
B	84%-86%	B-	80%-83%	C+	77%-79%
C	74%-76%	C-	70%-73%	D+	67%-69%
D	64%-66%	D-	60% - 63%	F	59% and below

Methods of Evaluation for Determining Grades

Assignment Detail for Course:

Assignments	**Possible Points**
Homeworks	450
Midterm Exam	250
Final Exam	300
Total Points Possible in Course	**1000**

Week by Week Outline for Course (Tentative):

Week	**Topics&Assignments**
Week 1	**Chapter 1 Probability (Chapter 1 of Probability and Simulation)** ● 1.1 Axioms of probability ● 1.2 Random sampling ● 1.3 Project: Verifying polynomial identities ● 1.4 Conditional probability and randomized surveys ● 1.5 Bayes' theorem **Chapter 2 Discrete random variables (Chapter 2 of Probability and Simulation)**

	• 2.1 Discrete random variables • 2.2 Expectation of a function of a random variable • 2.3 Discrete uniform random variables • 2.4 Bernoulli, binomial, geometric, Poisson random variables
Week 2	**Chapter 2 Discrete random variables (Chapter 2 of Probability and Simulation)** • 2.5 Conditional expectation • 2.6 Markov's inequality and Chebyshev inequality **Chapter 3 Continuous random variables (Chapter 3 of Probability and Simulation)** • 3.1 Uniform random variables and strong law of large numbers • 3.2 Exponential and normal random variables, central limit theorem **Midterm Exam**
Week 3	**Chapter 4 Joint distribution of random variables (Chapter 6 of Introduction to Probability)** • 6.1 Joint distribution of discrete random variables • 6.2 Jointly continuous random variables • 6.3 Joint distributions and independence • 6.4 Further multivariate topics **Chapter 5 Sums and symmetry (Chapter 7 of Introduction to Probability)** • 7.1 Sums of independent random variables
Week 4	**Chapter 6 Expectation and variance in the multivariate setting (Chapter 8 of Introduction to Probability)** • 8.2 Sample mean and sample variance • 8.4 Covariance and correlation • 8.5 The bivariate normal distribution • 8.6 Finer points
Week 5	**Chapter 7 Topics from conditional distributions and jointly continuous random variables (Chapter 10 of Introduction to Probability)** • 10.1 Conditional distribution of a discrete random variable • 10.2 Conditional distribution for jointly continuous random variables • 10.3 Conditional expectation

	Chapter 8 Moment generating functions (Sections 5.1 and 8.3 of Introduction to Probability) ● 8.1 Moment generating functions: discrete random variables ● 8.2 Moment generating functions: continuous random variables ● 8.3 Moment generating functions of sums of independent random variables **Final Exam**

Attendance Policy

Requirements for student attendance and participation will be defined by each instructor based on the following policy:

- Monday of the first week of the session is the first day of class.
- Regular attendance/engagement is expected for student success. Online engagement is evident through posting to a discussion board, blog, completing assignments including journal entries, or taking quizzes and exams. If regular attendance/engagement are not evident, the student's grade may be adversely affected. If a student misses more than one week of engagement in an online class, the student may, at the discretion of the instructor, fail the course.
- Students in courses with required synchronous class sessions are expected to remain for the full duration. If a student misses more than one required synchronous online class, the student may, at the discretion of the instructor, fail the course.
- Students must submit an academically-related assignment through the Learning Management System (LMS) before the end of Week 2 (i.e., a quiz, test, course content-related Discussion Board post, or other course content-related assignment). Introduction posts do not count as an academically-related assignment. If a student does not submit an academically-related assignment, the student will be administratively dropped from the course. Students administratively dropped for non-attendance/participation will not be reinstated in the course. In infrequent cases, students in certain classes may be exempt from the requirement to submit an academically-related assignment before the end of Week 2; students may consult with their instructor for further information.
- Students should consider withdrawing from a course if they will be unable to participate each week. Instructors may, but are not obligated to, accommodate students under extraordinary circumstances, but the student must request accommodation and provide requested supporting documentation.
- Schools and programs may have different attendance policies. Refer to school and program specific information for additional attendance policies.

Academic Integrity

The University of Massachusetts Global is an academic community based on the principles of honesty, trust, fairness, respect and responsibility. Academic integrity is a core University value, which ensures respect for the academic reputation of the University, its students, faculty and staff, and the degrees it confers. The University expects that students will conduct themselves in an honest and ethical manner and respect the intellectual work of others.

Submitting to faculty work completed by the use of any artificial intelligence tool without permission and/or when prohibited by class policy. When faculty require the use of technology, including artificial intelligence, as a part of an assignment for the course, there is no violation. Students are reminded to consult syllabi, assignment sheets/rubrics, program documents and their faculty. Use of artificial intelligence, when permitted, must be correctly cited in the assignment.

The UMass Global online library provides resources to support research, proper citation styles, and the safe and responsible use of generative artificial intelligence or Gen AI.

- The Academic Integrity and Plagiarism Avoidance page provides guidance to help students better understand academic integrity and includes tips on how to avoid plagiarism.
- The Citing Sources page offers guidance on how to properly cite using APA, MLA, and Chicago styles.
- The Artificial Intelligence Resource Guide for Students provides advice for understanding and appropriately using generative artificial intelligence tools such as ChatGPT and Bard.

UMass Global's Office of Accessible Education

Students who require disability-related services or accommodations to access their educational experience can register with the Office of Accessible Education (OAE). The Office of Accessible Education (OAE) is committed to ensuring equal educational access and opportunity for all members of our academic community. Students will be provided equitable and reasonable accommodations and services that are in compliance with Section 504 of the Federal Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 (ADA)/Americans with Disabilities Act Amendments Act of 2008 (ADAA). Registration with OAE is on a voluntary, self-identifying basis. Please visit the Office of Accessible Education (OAE) website for more information about how to register for services, eligibility requirements, and information about potential academic accommodations and services.

Our university is committed to ensuring equal access for all students. Let us know about any accessibility barriers you encounter using any of our online systems or websites by submitting a Feedback or Accessibility Concern Submission Form. We'll do our best to improve things and get you the information you need.

UMass Global’s CARES Team

The CARES team is a campus-wide team of appointed staff and faculty responsible for identifying, assessing, and responding to concerns and/or disruptive behaviors by students, faculty/staff, and community members who struggle academically, emotionally, or psychologically, or who present a risk to the health or safety of the university or its members.

Individuals may refer themselves or other community members of concern by emailing cares@umassglobal.edu or by filling out a referral form here. The CARES Team provides short term assessment, intervention, support, and recommendations of resources to those referred and engaged in the process.

UMass Global's Title IX Statement

The University of Massachusetts Global strives to maintain and foster a climate that promotes respect and human dignity. Sexual misconduct and relationship violence in any form is antithetical to the university's mission and core values, violates university policies, and may also violate federal and state law. The office of Title IX is primarily concerned for students' safety and well-being and is tasked with investigating all reports of sexual misconduct experienced by our community members. Title IX prohibits sex-based and gender-based discrimination and harassment, which includes discrimination based on pregnancy and/or pregnancy-related complications, parental status, and marital status. Students expecting or experiencing pregnancy-related complications, that may require educational accommodations, should contact the University's Title IX Coordinator and/or the Office of Accessible Education.

The University and Title IX's prohibition of sex discrimination also covers sexual harassment, sexual violence, and any other form of sexual misconduct. We offer options and resources to all students affected by these issues and are committed to providing a fair, thorough, and prompt investigation and adjudication process. If you or someone you know has been impacted by sexual assault, dating, and domestic violence, stalking, or sexual exploitation, please visit the University's Title IX Resource Page to access additional resources and information.

UMass Global's staff and faculty are tasked with reporting any possible sex or gender-based discrimination or Title IX violations to the University's Title IX Coordinator at civilrightscomplaints@umassglobal.edu.

Click on this Link to our University Title IX Policy