

MATH 464: THEORY OF PROBABILITY

Fall 2021 Section 2

Instructor:	Christina Durón	Class Modality:	In person
Email:	duronc@math.arizona.edu	Class Time:	MWF 1:00PM – 1:50PM
Office:	MATH 319; (520) 621 – 6870	Class Location:	Phys-Atmos Sci, Rm 220

Course Pages:

1. Homepage: <https://cduron.info/>
2. D2L: <https://d2l.arizona.edu/d2l/home/1066197>
3. Gradescope: <https://www.gradescope.com/courses/284552>

Office Hours: Office Hours will be held regularly on Mondays from 2:30PM – 3:30PM (Zoom), Wednesdays from 2:30PM – 3:30PM (Zoom), and Thursdays from 11AM - 12PM (Upper Division Tutoring; Teams), and by appointment. In addition, questions may be addressed through email. Please allow up to 24 hours for a response, although the instructor will strive to reply promptly.

Course Communications: All course materials will be posted on D2L and on the course homepage. Email, in-class announcements, and D2L announcements will be the primary methods to communicate course information. It is ultimately the student's responsibility to keep informed of any announcements, syllabus adjustments, or policy changes made during scheduled classes, by email, or through D2L.

Course Prerequisites or Co-requisites: MATH 323: Formal Mathematical Reasoning and Writing, or instructor permission.

Course Description: MATH 464 provides an introduction to the theory of probability, the part of mathematics that studies random phenomena. We model simple random experiments mathematically and learn techniques for studying these models. Topics covered include probability spaces, random variables, weak law of large numbers, central limit theorem, and various discrete and continuous probability distributions.

Course Goals and Objectives: MATH 464 is an introduction to probability theory. Topics to be covered include:

1. Chance experiments, probability spaces, probabilistic models.
2. Conditional probability, Bayes' theorem.
3. Independence.
4. Random variables: probability distributions, expectations and moments, functions of random variables, joint distributions, covariance and correlation, sums and moment generating functions, independence.
5. Limit theorems: Law of Large Numbers and Central Limit Theorem.

This course will prepare students for further courses in stochastic processes and mathematical statistics. It is a prerequisite for MATH 468: Applied Stochastic Processes and STAT 466: Theory of Statistics.

Expected Learning Outcomes: Upon completion of the course, the student will

1. be able to set up and interpret probability models for a variety of chance experiments;
2. be able to interpret, explain, and apply probabilistic concepts such as probability, conditional probability, independence, expectations;
3. be able to “think probabilistically”, e.g., break down long calculations of probabilities and/or expectations into simpler steps;
4. understand the relationship between random variables and their distributions/densities;
5. understand the meaning, scope, and consequences of the Law of Large Numbers and the Central Limit Theorem, including the meaning of convergence in distribution and convergence with probability 1;
6. be able to carry out concrete calculations with common distributions, e.g., the normal, exponential, and uniform distributions.

Course Materials: The required textbook is *Introduction to Probability* by Anderson, Seppäläinen, and Valkó. Reading assignments and homework problems will be given directly from the text.

The textbook is being delivered digitally via D2L through the Inclusive Access program. Please access the material through D2L the first day of classes to make sure there are no issues in the delivery, and if you are having a problem or question, it can be addressed quickly. You automatically have access to the course materials FREE through September 5. But you must take action (even if you have not accessed the materials) to opt-out if you do not wish to pay for the materials, and choose to source the content independently. The deadline to opt-out for this course is 9:00PM MST, September 5. If you do not opt-out and choose to retain your access, the cost of the digital course materials will appear on your October Bursar’s account. For more information, visit the FAQs page at <https://shop.arizona.edu/textbooks/Inclusive.asp>.

Required Materials: No materials other than the textbook is required. However, you will be expected to download and upload homework online through Gradescope. It is your responsibility to learn how to do this. Paper will be provided during examinations.

Course Recordings: The instructor will try to record each lecture to be made available on D2L after each class. For lecture recordings, which are used at the discretion of the instructor, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with [UArizona values](#) and educational policies ([Code of Academic Integrity](#) and the [Student Code of Conduct](#)) are also subject to civil action.

Absence and Class Participation Policy: Participating in the course and attending lectures and other course events are vital to the learning process. As a result, daily attendance is expected from every student. Students who miss the first class meeting may be administratively dropped unless they have made other arrangements. If you have three or more unexcused absences, you may be administratively dropped from the course. In addition, prolonged absences and absence during exams should be communicated to the instructor as soon as possible. If you are unexpectedly absent for medical or personal reasons, please inform the instructor within 24 hours, if at all possible.

Please note the following:

- All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion.
- Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored.

It is the student's responsibility to notify the instructor in advance of an absence related to religious observation or an activity for which a Dean's excuse has been granted, and to arrange for how any missed work will be handled.

In addition, the University's policies regarding attendance, participation, and administrative drops are listed below

- The UA policy concerning Class Attendance, Participation, and Administrative Drops is available at <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>.
- The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, and is available at <https://policy.arizona.edu/human-resources/religious-accommodation-policy>.
- Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. The policy is available at <https://deanofstudents.arizona.edu/absences>.

As we enter the Fall semester, the health and wellbeing of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit the [UArizona COVID-19 page](#) for the latest guidance.

If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel. Notify your instructor if you will be missing class or an assignment deadline. Non-attendance for any reason does not guarantee an automatic extension of due date or rescheduling of examinations/assessments. Please communicate and coordinate any request directly with your instructor.

If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing. Voluntary, free, and convenient COVID-19 testing is available for students on [Main Campus](#). If you test positive for COVID-19 and you are participating in on-campus activities, you must report your results to Campus Health. To learn more about the process for reporting a positive test, visit the [Case Notification Protocol](#). The COVID-19 vaccine is available for all students at [Campus Health](#). Please visit the [UArizona COVID-19 page](#) for regular updates.

Disability-Related Accommodations: At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the [Disability Resource Center](#) at (520) 621-3268 or drc-info@email.arizona.edu to establish reasonable accommodations. Confirm with your instructor if you have requested accommodation.

Classroom Behavior Policy: To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing). Students are asked to refrain from disruptive conversations during

lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

Threatening Behavior Policy: The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. The policy is available at <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

UA Nondiscrimination and Anti-harassment Policy: The University is committed to creating and maintaining an environment free of discrimination; the policy is available at <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Academic Advising: If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call (520) 626 – 8667 or email to advising@arizona.edu.

Life Challenges: If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office can be reached at (520) 621– 2057 or DOS-deanofstudents@email.arizona.edu.

Physical and Mental-Health Challenges: If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520) 621– 9202. For After Hours care, call (520) 570 – 7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621– 3334.

Assignments and Examinations:

- *Weekly homework* will be distributed electronically (typically on Gradescope and D2L), based in part on the text. Students are responsible for uploading properly scanned work to Gradescope by 11:59PM on the indicated due date. The instructor will grade either a subset or all of the problems each week; graded work will be returned through Gradescope. Students must show all work in a legible, neat and organized manner to receive credit. No credit will be given if the solution is not justified, or if the work is illegible.
- *Two in-class midterms* are tentatively scheduled on Friday, October 1 and Wednesday, November 10. Each exam will be written to be completed within 50 minutes. An additional 5 minutes will be provided to allow work to be submitted to Gradescope. Students must show all work in a legible, neat and organized manner to receive credit. No credit will be given if the solution is not justified, or if the work is illegible.
- The *final exam* will take place on Monday, December 13, 2021, at 1 – 3PM in our regular classroom. Within the 2 hours, students are expected to submit their work to Gradescope. The grading policy for the midterm exams will be observed for the final exam. Please visit [Final Exam Regulations and Schedule](#) for more information.

You are permitted, indeed encouraged, to work together on homework problems. However, the work

you turn in must be your own. For midterms and the final, the [University's Exam regulations](#) will be strictly followed.

Important Dates:

Midterm #1 October 1, 2021 (tentative)
Midterm #2 November 10, 2021 (tentative)
Final Exam December 13, 2021

Make-up Exams and Homework Extensions: In general, there will be no make-up exams. However, in unusual circumstances beyond your control, a make-up exam may be given on a case-by-case basis. This may require providing a detailed account of the situation and, if applicable, supporting documents. Approval in these cases is at the sole discretion of the instructor and/or the Dean of Students. According to University policy, no exams will be held during the week of December 6th.

Homework assignments not turned in by the due date will receive an automatic zero. Extensions may be granted on a case by case basis, either with prior permission of the instructor (a valid reason must be given) or with the instructor's agreement in cases of emergency. In the latter case, the student must contact the instructor within 24 hours, if possible.

Grading Scale and Policies: Your letter grade in the course will be based on the following:

- Homework (25%)
- Midterms (40%; 20% each)
- Final (35%)

Your final letter grade will be *no lower* than the following:

A: 100 – 90% B: 89 – 80% C: 79 – 70% D: 69 – 60% E: 59 – 0%

No extra credit or bonus points are offered in this course.

Incomplete or Withdrawal Requests: Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, both are available at <https://catalog.arizona.edu/policy/grades-and-grading-system>.

You may drop the class without a W through September 5 using UAccess. The class will appear on your UAccess record, but will not appear on your transcript. You may withdraw with a W through October 31 using UAccess. The University allows withdrawals through November 21, but only with the Dean's approval. Late withdrawals are dealt with on a case by case basis, and requests for late withdraw without a valid reason may or may not be honored.

Dispute of Grade Policy: Except with instructor's permission, any questions regarding the grading of any assignment or exam need to be raised within one week after the graded item has been returned.

Code of Academic Integrity: Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to

the UA Code of Academic Integrity as described in the UA General Catalog, which is available at <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for re-sale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

Additional Resources for Students: UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>.

Information on the Student Assistance and Advocacy is available at <http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>.

Information on the Confidentiality of Student Records is available at <http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>.

Tentative Schedule:

MONDAY	WEDNESDAY	FRIDAY
Aug 23rd 1 Probability Spaces (Section 1.1)	25th 2 Counting (Section 1.2)	27th 3 Infinite Sample Spaces (Section 1.3)
30th 4 Rules of Probability (Section 1.4) HW #1 Due	Sep 1st 5 Conditional Probability (Section 2.1)	3rd 6 Bayes' (Section 2.2)
6th 7 NO CLASS	8th 8 Independence (Section 2.3) HW #2 Due	10th 9 Random Variables (Section 1.5)
13th 10 Distribution of Random Variables (Section 3.1) HW #3 Due	15th 11 Cumulative Distribution Functions (Section 3.2)	17th 12 Independent Trials (Section 2.4)

MONDAY	WEDNESDAY	FRIDAY
20th 13 Independent Trials (Section 2.4) HW #4 Due	22nd 14 Expectation (Section 3.3)	24th 15 Expectation (Section 3.3)
27th 16 Variance (Section 3.4) HW #5 Due	29th 17 Midterm #1 Review	<div>Oct 1st</div> 18 Midterm #1
4th 19 Gaussians (Section 3.5) HW #6 Due	6th 20 Normal Approximations (Section 4.1)	8th 21 Law of Large Numbers (Section 4.2)
11th 22 Applications of the Normal Approximation (Section 4.3) HW #7 Due	13th 23 Poisson Approximation (Section 4.4)	15th 24 Exponential Distribution (Section 4.5)
18th 25 Moment Generating Function (Section 5.1) HW #8 Due	20th 26 Moment Generating Function (Section 5.1)	22nd 27 Distribution of a Function of a Random Variable (Section 5.2)
25th 28 Joint Distribution of Discrete Random Variables (Section 6.1) HW #9 Due	27th 29 Joint Distribution of Discrete Random Variables (Section 6.1)	29th 30 Jointly Continuous Random Variables (Section 6.2)
<div>Nov 1st</div> 31 Jointly Continuous Random Variables (Section 6.2) HW #10 Due	3rd 32 Joint Distributions and Independence (Section 6.3)	5th 33 Sums of Independent Random Variables (Section 7.1)

MONDAY	WEDNESDAY	FRIDAY
8th 34 Midterm # 2 Review HW #11 Due	10th 35 Midterm # 2	12th 36 Linearity of Expectation (Section 8.1)
15th 37 Expectation and Independence (Section 8.2) HW #12 Due	17th 38 Covariance and Correlation (Section 8.4)	19th 39 Sums and Moment Generating Functions (Section 8.3)
22nd 40 Law of Large Numbers (Section 9.2) HW #13 Due	24th 41 Central Limit Theorem (Section 9.3)	26th 42 Conditional Distribution of a Discrete Random Variable (Section 10.1)
29th 43 Conditional Distribution for Jointly Continuous Random Variables (Section 10.2) HW #14 Due	<div>Dec 1st</div> 44 Conditional Expectation (Section 10.3)	3rd 45 NO CLASS
6th 46 Final Exam Review HW #15 Due	8th 47 Final Exam Review	10th 48
13th 49 Final Exam: 1-3PM	15th 50	17th 51

Note: This calendar is tentative. For up-to-date information, see the course page on D2L.

Subject to Change Statement: Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.