

Math 4810 Probability
SPRING 2018
Department of Mathematical and Statistical Sciences
University of Colorado Denver

Instructor: Burt Simon

Office: AB 4209

Office Hours: MW 12:00-1:00, or by appointment

Phone: 303 315 1710

Website: www.math.ucdenver.edu/~bsimon

Email: burt.simon@ucdenver.edu

Course dates/times: MW 2:00 – 3:15

Course location:

Text: Fundamentals of Probability
with Stochastic Processes, 3rd ed.
by Saeed Ghahramani

Welcome! Probability is a fascinating and very useful mathematical theory. Math 4810 is a standard introduction to probability theory. By successfully completing this course you will be ready to take courses in mathematical statistics, probabilistic modeling, stochastic processes, financial engineering, actuarial science, and various engineering fields. Please check the class web page regularly, which can be linked to from my page at math.ucdenver.edu/~bsimon. The class web page will have the weekly assignments, announcements, exam solutions, etc. I encourage students to participate in class by asking questions and answering (rhetorical) questions that I ask during class.

University Course Catalog Description:

Examines elementary theory of probability, including independence, conditional probability, and Bayes' theorem; random variables, expectations and probability distributions; joint and conditional distributions; functions of random variables; limit theorems, including the central limit theorem. Note: No co-credit with MATH 3800. Prereq: MATH 3191; Coreq: MATH 2421. **Semester Hours:** 3 to 3

Course Overview: Introductory probability courses like this one cover axioms of probability, combinatorial probability, conditional probability, random variables (discrete, continuous, and multivariate), Expected value (mean, moments, variance, covariance, etc.), and some limit theorems (laws of large numbers, Central Limit Theorem).

Course Goals and Learning Objectives:

- A. Overall Learning Objectives: By successfully completing this course, students will be familiar with all the basic concepts of probability theory listed in the Course Overview, and will understand how they tie together. Students will be able to calculate probabilities, expected values, etc., and be able to formulate probabilistic solutions for simple applied problems.
- B. Learning Outcomes:
 - Problem Solving: Students will learn to solve problems involving uncertainty that are posed as generic probability calculations, and as real-world

- applications of probability theory.
 - Creative Thinking: Students will learn to distill a probability problem from a description where it may not be obvious how probability theory applies
 - Critical Thinking: It is easy to misapply probability theory, so students will learn to apply the theory correctly.
- C. Major Topics: axioms of probability, combinatorial probability, conditional probability, random variables (discrete, continuous, and multivariate), Expected value (mean, moments, variance, covariance, etc.), and some limit theorems (laws of large numbers, Central Limit Theorem).
- D. Rationale: Probability is required as a prerequisite for many upper division math courses, like statistics, probabilistic modeling, stochastic processes; and is useful in business, engineering, and other technical fields.

Course Prerequisites: Math 3191 (linear algebra)

Course Credits: 3 credit hours

Required Texts and Materials: Fundamentals of Probability with Stochastic Processes, third edition, by Saeed Ghahramani

Course Schedule:

The following schedule of course materials covered is tentative.

<u>DATES (class times)</u>	<u>TOPICS</u>	<u>SECTIONS FROM TEXT</u>
January 17	Axioms of probability	sections 1.1 - 1.7
January 22, 24	Combinatorial methods	sections 2.1 - 2.4
Jan. 29, 31	Conditional probability	sections 3.1 - 3.5
February 5, 7	Discrete random variables	sections 4.1 - 4.5
February 12, 14	Discrete random variables	sections 5.1 - 5.3
February 19, 21	Review and Exam #1	
Feb. 26, 28	Continuous random variables	sections 6.1 - 6.3
March 5, 7	Continuous random variables	sections 7.1-7.5
March 12, 14	Multi-variate distributions	sections 8.1 - 8.3 and 9.1
March 19-23	Spring Break	
March 26, 28	Multi-variate distributions	sections 9.1 - 9.3
April 2, 4	Review and Exam #2	
April 9, 11	$E(X)$, $\text{Var}(X)$, $\text{Cov}(X,Y)$, $\text{Cor}(X,Y)$	sections 10.1 - 10.3
April 16, 18	Conditioning on random variables	sections 10.4 - 10.5
April 23, 25	Sums of r.v.'s and limit theorems	sections 11.1 - 11.5
April 30, May 2	Catch-up and Review	
May 7-11	Final exam (date to be announced)	

Assignments: I will assign homework problems from the textbook (approximately) weekly. Typically the assignment will be posted on the class web page on Monday or Tuesday, and will be due the following Monday. Homework sets will be discussed in class the day they are due, and there will often be a quiz based on the homework following the discussion.

Working collectively on the homework assignments is encouraged!

Basis for Final Grade: Your final grade will be based on your exam scores (two midterm exams and a final exam), quizzes, and intangibles such as class participation. The intangibles can only increase your grade.

In the absence of “intangibles”, your final grade will be a weighted average of the letter grades on your exams and quizzes. The weightings will be as follows: Quizzes (20%), Midterm Exam #1 (25%), Midterm Exam #2 (25%), Final Exam (30%).

Grade Dissemination: I will try to grade quizzes and exams by the next class after they are taken. They will be returned in class with grades on them. If you sense a mistake in my grading, please send me an email, or come to my office hours to discuss.

Course Policies

- A. Attendance:** I will not take attendance, but students are expected to attend every class. You will be responsible for material I cover in class, whether or not it is in the textbook. Class participation is one of the important “intangibles” that can impact your grade.
- B. Extra Credit Policy:** There is no “extra credit” in general, but students can try to raise their grades by being attentive (and participating constructively) in class, and demonstrating competence in my office hours.
- C. Grades of “Incomplete”:** I will follow university procedures on “incompletes”, i.e., they are only given in situations where unexpected emergencies prevent students from completing the course and the remaining work can be easily finished the following semester. Incomplete work must be finished the next semester or the grade automatically turns into an F.
- D. Group Work Policy:** Students are encouraged to collaborate on homework sets, as long as they acknowledge their collaborators. There is no penalty for working together. Of course, no collaboration is allowed on exams, as that is considered cheating.
- E. Announcements:** I will use the class web page for all communication that is meant for the whole class. Please check the page regularly. Private communication is best done by email. I will typically respond within a day.
- F. Laptops, Cell Phones, etc.:** You are free to use your devices as you see fit during class. (No phone calls or texting, of course.) The rules during exams will be announced prior to the tests. Usually my exams are open-book, open-notes, but electronic devices (calculators, computers, etc.) are not allowed.
- G. Civility:** Students are expected to be quiet and attentive during class, although raising your hand to ask a question or make a comment is welcome and encouraged.

- H. Dishonesty:** Students are expected to understand intuitively what proper ethical conduct means in the context of a college mathematics course. If you are caught cheating you could fail the class or (at least) have your grade lowered, so don't even try it.

Academic Policies

The following policies, procedures, and deadlines pertain to all students taking courses in the College of Liberal Arts and Sciences (CLAS). They are aligned with the Official University Academic Calendar found on the [Registrar's website](#).

Schedule Verification

It is each student's responsibility to verify that their official registration and schedule of courses is correct in UCDAccess (*not* Canvas) before courses begin and by the university census date. Failure to verify schedule accuracy is not sufficient reason to justify post-census date adds. Access to a course through Canvas is not evidence of official enrollment.

Email

Students must activate and regularly check their official CU Denver email account for university related messages. Note: Canvas is not the location to access your CU Denver email account. Log into <http://www.ucdenver.edu/email/Pages/login.aspx>

Administrative Drops

Students may be administratively dropped if they do not meet the pre- and/or co-requisites for a course as detailed in the UCDAccess registration system. Students may also be administratively dropped from a course if the course syllabus articulates attendance expectations prior to census date and they do not meet those attendance expectations. Please note: this procedure does not apply to all courses and students should not rely upon it; if students plan to no longer complete a course, they are responsible to drop or withdraw from the course.

Post-Census Date Adds and Late Withdrawals

Post-census date adds (i.e., adding a course after census date) require a written petition, verifiable documentation, and dean's approval via CLAS Advising. Late withdrawals (i.e., withdrawing from one or more full-semester courses after the withdrawal deadline but before the late withdrawal deadline) require a [Late Withdrawal Petition](#) submitted to CLAS Advising (NC 1030 - 303-315-7100). If petitioning to late-withdraw from individual courses, instructor signatures are required. If petitioning to late-withdraw from the entire semester, instructor signatures are not required. Contact CLAS Advising (NC 1030 - 303-315-7100) for more information on post-census date adds and late withdrawals.

Co-Requisites and Drops/Withdrawals

Students dropping a course with co-requisite(s) before or by census date must drop the course and co-requisite(s). After census date, students withdrawing from a course with co-requisite(s) before or by the withdrawal deadline must withdraw from the course and co-requisite(s). After the withdrawal deadline, until the late withdrawal deadline, students may be able to withdraw from a course or co-requisite(s) based on instructor permission and approval of a [Late Withdrawal Petition](#).

Waitlists

The Office of the Registrar notifies students via their CU Denver email account if they are added to a course from a waitlist. Students will have access to Canvas when they are on a waitlist, but this does not indicate that the student is officially enrolled or guaranteed a seat in the course. If a student is not enrolled in a course after waitlists are purged, instructor permission is required for the student to enroll in the course. The student must complete a [Late Add Form](#) and submit it to the Registrar's Office (SCB 5005) by census date in order to enroll in the course.

Applicable Forms

<u>Schedule Adjustment Form</u>		Submit to Registrar (SCB 5005)
Purpose:	Approval Signatures Required:	Dates:
Receive an academic overload	Student and CLAS Advising signatures	before Jan. 31 (5pm)
Receive a time conflict override	Student and instructor signatures	before Jan. 31 (5pm)
Designate a course pass/fail or no credit	Student signature	before Jan. 31 (5pm)
Withdraw from an intensive course before the withdrawal deadline	Student signature	Feb. 1 - April 1 (5pm)

<u>Late Add Form</u>		Submit to Registrar (SCB 5005)
Purpose:	Approval Signatures Required:	Dates:
Add a course after the add deadline but before census date	Student and instructor signatures	Jan. 22 - Jan. 31 (5pm)

Post-Census Date Add Petition		Visit CLAS Advising (NC 1030) for more information
Purpose:	Approval Required:	Dates:
Petition to add one or more full-semester courses after census date (verifiable documentation required)	Submitted petitions are reviewed by the CLAS Assistant Dean	after Jan. 31

<u>Late Withdrawal Petition</u>		Submit to CLAS Advising (NC 1030)
Purpose:	Approval Signatures Required:	Dates:
Petition to late-withdraw from a course after the withdrawal deadline but before the late withdrawal deadline	Student and instructor signatures	April 2 - May 2 (5pm)
Petition to late-withdraw from <u>all courses</u> in the semester after the withdrawal deadline but before the late withdrawal deadline	Student signature	April 2 - May 2 (5pm)

Academic Calendar	
January 16	Beginning of Semester - First day of classes.
January 21 (11:59 pm)	Add Deadline - Last day to add or waitlist a course using UCDAccess. After the add deadline but before census date, instructor permission on a Late Add Form is required to add courses.
January 22 (11:59 pm)	<p>Drop Deadline - Last day to drop a course without \$100 drop fee, including section changes (i.e., changing to a different section of the same course). Students may drop courses using UCDAccess.</p> <p>No Adding of Courses is Permitted Today</p> <p>Waitlists Purged - All waitlists are eliminated today. Students should check their schedule in UCDAccess to confirm the courses in which they are officially enrolled. Canvas does not reflect official enrollment.</p>
January 31 (5 pm)	<p>Final Add Deadline (Instructor Permission Required)</p> <p>Last day to add full-semester courses. To add a full-semester course between the first add deadline and census date, instructor permission on a Late Add Form is required. Students may submit a completed Late Add Form to the Registrar's Office (SCB 5005).</p> <p>After census date, a written petition, verifiable documentation, and dean's approval via CLAS Advising (NC 1030 - 303-315-7100) are required to add a full-semester course. If a student's post-census date add petition is approved, the student will be charged the full tuition amount. College Opportunity Fund (COF) may not apply to courses added late, and these credits may not be deducted from students' lifetime hours.</p>
Census Date	

	<p>Final Drop Deadline</p> <p>Last day to drop full-semester courses with a financial adjustment. Each course dropped, including section changes, between the first drop deadline and census date generates a \$100 drop fee. Students may drop courses in UCDAccess.</p> <p>After census date, withdrawal from courses appears on transcripts with a grade of "W," and no financial adjustment is made.</p> <p>After census date but before the withdrawal deadline, students may withdraw from full-semester courses using UCDAccess (instructor permission is not required).</p> <p>Graduation Application Deadline</p> <p>Last day to apply for graduation. Undergraduates are expected to make an appointment to see their academic advisors before census date to apply for graduation. Graduate students must complete the Intent to Graduate and Candidate for Degree forms.</p> <p>Pass/Fail, No Credit Deadline - Last day to request No Credit or Pass/Fail grade for a course using a Schedule Adjustment Form.</p>
March 19 – 25	Spring Break - No classes. Campus open.
April 1 (11:59 pm)	<p>Withdrawal Deadline</p> <p>After census date, students may withdraw from full-semester courses using UCDAccess (instructor permission is not required). To withdraw from an intensive course, students may use a Schedule Adjustment Form.</p> <p>Withdrawal from courses appears on transcripts with a grade of "W" and no financial adjustment is made.</p> <p>After the withdrawal deadline but before the late withdrawal deadline, students may late-withdraw by submitting a Late Withdrawal Petition to CLAS Advising (NC 1030 - 303-315-7100). Contact CLAS Advising (NC 1030 - 303-315-7100) for more information.</p> <p>After census date, students withdrawing from a course with co-requisite(s) before or by the withdrawal deadline must withdraw from the course and co-requisite(s). After the withdrawal deadline, until the late withdrawal deadline, students may be able to withdraw from a course or co-requisite(s) based on instructor permission and approval of a Late Withdrawal Petition.</p>
May 2 (5 pm)	<p>Late Withdrawal Deadline</p> <p>Last day to petition to late-withdraw from one or more full-semester courses. Students may petition to late-withdraw by submitting a Late Withdrawal Petition to CLAS Advising (NC 1030 - 303-315-7100). If petitioning to late-withdraw from individual courses, instructor signatures are required. If petitioning to late-withdraw from the entire semester, instructor signatures are not required. Contact CLAS Advising (NC 1030 - 303-315-7100) for more information.</p> <p>After the withdrawal deadline, until the late withdrawal deadline, students may be able to withdraw from a course with co-requisite(s) based on instructor permission and approval of a Late Withdrawal Petition.</p> <p>After the late withdrawal deadline (or after grades are posted, whichever is sooner), only retroactive withdrawals are considered and verifiable documentation is required. Contact CLAS Advising (NC 1030 - 303-315-7100) for more information on retroactive withdrawals.</p>
May 7 – 12	Finals Week
May 12	<p>End of Semester</p> <p>Commencement Ceremony</p>
May 17	Final Grades Available - Official grades available in UCDAccess and transcripts (tentative). Canvas does not display final grades.
June 22	Degrees Posted - Degrees posted for graduating students on transcripts.