

# STAT 3508 A: Elements of Probability Theory

## COURSE OUTLINE

<b>Term</b>	Fall 2020
<b>Instructor</b>	Dr. Natalia Stepanova
<b>Email</b>	<a href="mailto:nstep@math.carleton.ca">nstep@math.carleton.ca</a>
<b>Website</b>	<a href="http://culearn.carleton.ca/">http://culearn.carleton.ca/</a>
<b>Timetable</b>	The course involves two lectures and one-hour tutorial per week. Tutorials will start on <b>September 18th, 2020</b> .
<b>Lectures</b>	Lectures will be delivered through posting lecture notes on cuLearn on a weekly basis, every Monday, starting the week of September 7th. The introductory lecture on <b>September 9th</b> will be delivered synchronously via Big Blue Button (BBB) and starts at 1:05 pm.
<b>Instructor's office hours</b>	Fridays, 1:30 pm – 2:30 pm, or by appointment. Office hours will be conducted synchronously via Big Blue Button. Questions pertaining to general course material, suggested problems, and/or tutorials may be asked during the BBB session or sent to the instructor by email at least one hour prior to the start of the BBB session.
<b>Tutorials</b>	Fridays, 3:35 pm – 4:25 pm. Tutorials will be conducted synchronously via Big Blue Button. Attendance during tutorials is encouraged as it provides a way to connect with the TA and classmates.
<b>TA</b>	Joshua Miller; email: <a href="mailto:JoshuaMiller@cmail.carleton.ca">JoshuaMiller@cmail.carleton.ca</a>
<b>TA's office hours</b>	Wednesdays, 3:00 pm – 3:30 pm. Office hours will be conducted synchronously via Big Blue Button.
<b>Assignments</b>	There will be <b>six assignments</b> with specific due dates. Late assignments will not be accepted. Due dates for assignments are tentatively scheduled for September 25, October 9, October 23, November 13, November 27, and December 9, 2020.
<b>Tests</b>	There will be <b>two 80-minute tests</b> . The tests are scheduled for <b>October 14</b> and <b>November 18, 2020</b> , from 1:00 pm to 2:20 pm.
<b>Grading</b>	Final exam: 40%      Tests: 30% (15% each)      Assignments: 30% (5% each)
<b>Textbook</b>	1. Probability and Statistics, 4th edition, by M. H. DeGroot and M. J. Schervish. 2. Student Solutions Manual, by M. H. DeGroot and M. J. Schervish. Student Solutions Manual contains fully worked solutions to all odd exercises in the textbook.
<b>Important Notes</b>	1. Lecture notes, assignments and their solutions, problem sets for tutorials, and announcements will be posted on cuLearn. Students should check the course web page on cuLearn on a regular basis. 2. <b>All materials created for this course</b> (including lecture notes, assignments, posted solutions, etc.) <b>remain the intellectual property of the instructor</b> . These materials are intended for the personal and non-transferable use of

students registered in the current offering of the course. **Reposting, reproducing, or redistributing any course materials**, in part or in whole, without the written consent of the instructor, **is strictly prohibited**.

3. There is a separate **Plagiarism Policy** document for this course that is located on cuLearn. Students **must read** the document thoroughly and **must agree to adhere to this policy** (and to all policies stated in this Course Outline) **within the first two weeks of classes**.

#### **Assignments, tests, and final exam policies:**

1. Assignments are **mandatory** and you will use cuLearn to submit your assignments. Be sure to write your own solutions and show all of your work (i.e., include every step). **All assignments count towards the term mark**. You are expected to work on your assignments consistently once they are released. As a result, you will never be granted an exemption from an assignment, even for a legitimate medical reason, and no extra credit assignments will be available. Assignments submissions will be handled electronically (i.e., via cuLearn) and there is no “grace period” with respect to a deadline – an assignment submitted even one minute after the deadline is late and will receive a mark of zero. Technical problems do not exempt you from this requirement. Consequently, you are advised to attempt to submit your assignment at least one hour prior to the due date and time. For each assignment, you will be submitting exactly one (1) pdf-file created using Microsoft Office, Google Docs, or LaTeX. Compressed files (e.g., “zip”, “rar”, etc.) or documents in another format (e.g., “doc”, “rtf”, etc.) will be penalized and may receive a mark of zero. If any of the files you submit cannot be opened it will receive a mark of zero. Consequently, after you upload your submission on cuLearn you must re-download it immediately and ensure that: (a) your submission is the correct type of file and has the correct filename; (b) each of your pdf-files can be opened with Adobe Acrobat Reader (for marking purposes).
2. Tests are **mandatory** and, due to the online nature of this class, **open-book**. **Open-book** refers to class materials only (lecture notes, tutorial videos, and textbook). Test question papers will be available on cuLearn during the scheduled test hours. You will be given 15 minutes to scan and submit your test answer paper via cuLearn. There will be no make-up tests.
3. Three-hour **open-book** final exam will be scheduled by Carleton University. **Open-book** refers to class materials only (lecture notes, tutorial videos, and textbook). Exam question paper will be available on cuLearn during the scheduled exam hours.
4. In normal circumstances, students with **illness during the span of time a test or exam is offered** might be granted an exemption only if they provide a copy of the Carleton University Medical Certificate [https://carleton.ca/registrar/wp-content/uploads/med\\_cert.pdf](https://carleton.ca/registrar/wp-content/uploads/med_cert.pdf) that has been completed and signed by a physician covering the period in question. **COVID-19 note:** We understand during the current COVID-19 situation, a medical note by a physician may be difficult to obtain. If you miss midterm test, you may elect to submit the self-declaration form [https://carleton.ca/registrar/wp-content/uploads/COVID-19\\_Self-declaration.pdf](https://carleton.ca/registrar/wp-content/uploads/COVID-19_Self-declaration.pdf) instead of obtaining a medical note, in which case the instructor might consider shifting the weight of the test to the final exam. (Currently the university process for accommodations is being reviewed. An update will be provided as soon as new accommodation policies are released.)

**Objectives of the course:** if a student reads every lecture, completes every assignment, regularly attends online tutorials, and solve suggested problems at the end of every lecture, then, by the end of this course, that student should learn the basic methods and tools of

probability theory, be able to use these methods to solve a variety of probability problems, including those emerging in real-life applications, and be prepared to make statistical inference in the subsequent STAT 3509 class in winter term.

### **Academic Accommodation**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

**Pregnancy obligation:** write to your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website

<http://www2.carleton.ca/equity/accommodation/>.

**Religious obligation:** write to your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website

<http://www2.carleton.ca/equity/accommodation/>.

**Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send the instructor your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, email to your instructor to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable) at <http://www2.carleton.ca/pmc/new-and-current-students/dates-and-deadlines/>. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at <http://www2.carleton.ca/equity/>.

**Academic Integrity:** The University states unequivocally that it demands academic integrity from all its members. Academic dishonesty, in whatever form, is ultimately destructive to the values of the University. Students who violate the principles of academic integrity through dishonest practices undermine the value of the Carleton degree. Dishonesty in scholarly activity cannot be tolerated. Any student who violates the standards of academic integrity will be subject to appropriate sanctions. For more details visit the Registrar's Office website <https://carleton.ca/registrar/academic-integrity/>.

### **Important dates:**

- September 9, 2020: Fall term classes begin.
- September 23, 2020: Last day for registration. Last day to change courses or sections for fall term courses.

- September 30, 2020: Last day to withdraw from fall term courses with a full fee adjustment. Withdrawals after this date will result in a permanent notation of WDN on the official transcript.
- October 9, 2020: December examination schedule available online.
- October 12, 2020: Statutory holiday. University closed.
- October 26-30, 2020: Fall break, no classes.
- November 13, 2020: Last day to request formal exam accommodations for December examinations to the Paul Menton Centre for Students with Disabilities.
- December 11, 2020: Last day of fall term classes. Last day for academic withdrawal from fall term courses.
- December 12-23, 2020: Final examinations in fall term courses will be held.
- December 25, 2020 through January 1, 2021 (inclusive): University closed.

**STAT 3508 A**

**Approximate weekly outline**

**Fall 2020**

Week	Topics	Text sections
1	Experiments and events. Relations and operations from set theory. The definition of probability. Basic properties of probability.	1.1-1.5 and 1.10
2	Finite sample spaces. Counting methods. Multinomial coefficients. Conditional probability.	1.6-1.9 and 2.1
3	Law of total probability. Bayes' theorem. Random variables and their distributions. Discrete random variables. Continuous random variables.	2.3, 3.1-3.2
4	Cumulative distribution function. Quantile function and quantiles. Bivariate distributions.	3.3-3.4
5	Marginal distributions. Independent random variables. Conditional distribution. Multivariate distributions.	3.5-3.7
6	Marginal joint distributions. Independent random variables (general case). Conditional distributions (general case). Functions of a random variable. Change-of-variable technique for real-valued functions of a single random variable.	3.7-3.8
7	Change-of-variable technique for real- and vector-valued functions of two or more random variables. Transformation of a multivariate p.d.f. Expectations of discrete and continuous random variables.	3.9, 4.1
8	Properties of expectations. Variance and its properties. Moments. Moment generating functions and their properties.	4.2-4.4
9	The mean and the median. Covariance and correlation and their properties. Conditional expectation and its properties. The best prediction.	4.5-4.7
10	Special discrete distributions (Bernoulli and binomial distributions, hypergeometric distribution, Poisson distribution, negative binomial distribution) and their properties.	5.2-5.5
11	Special continuous distributions (normal distribution, gamma distribution, beta distribution, bivariate normal distribution) and their properties.	5.6-5.8, 5.10
12	Markov's and Chebyshev's inequalities. The Law of Large Numbers. The Central Limit Theorem.	6.2-6.3

**Warning:** The above weekly schedule is subject to change. Make sure you keep up to date with any changes in order of presentation, etc.