STAT*3100: Introductory Mathematical Statistics I (0.5 Credit)

Fall 2024

Department of Mathematics and Statistics

College of Engineering and Physical Sciences

University of Guelph, Main Campus

1 General information

Course description: Probability spaces; discrete and continuous random variables; multivariate distributions; expectations; moments; Chebyshev's inequality; product moments; sums of random variables; generating functions; Gamma, Beta, t and F distributions; central limit theorem; sampling distribution.

Prerequisites: (1 of IPS*1510, MATH*1210, MATH*2080), (STAT*2040 or STAT*2120)
Lecture Time and Location:
Method of Delivery: Face-to-Face (in person)
Final Exam: Face-to-Face (in person), Friday December 13, 11:30am-1:30pm

2 Course Content

Specific Learning Outcomes: After the completion of the course, students should be able to

- State the axioms of probability, and derive probability theorems from these axioms.
- Answer probability questions using rules of probability.
- Define random variables association with outcomes of an experiment or a study.

- Carry out probability calculations for various discrete and continuous probability distributions, and choose the appropriate probability distribution in different scenarios.
- Derive the mean, moments, and the moment generating function of a given probability distribution.
- Derive marginal and conditional probability distributions from a joint distribution, and interpret their meaning.
- Derive the distributions functions of random variables.
- State characteristics of various discrete and continuous probability distributions.
- Explain the meaning of various statistical terms, such as random variable, expectation, moments, moment generating function, distribution, density, and independence.
- Understand and apply Chebyshev's inequality, central limit theorem, and the sampling distributions.
- Describe the mathematical underpinnings of the t, F, and chi-square distributions.

Lecture Content and Tentative Schedule:

Week 1-2.5: Introduction, counting rules (combination, permutations, binomial coefficient).

Week 2.5-3: Probability theory and concepts (sample spaces, experiment outcomes, events, probability rules, conditional probability, independency, Bayes' theorem).

week 4-5: Random variables, probability distributions and probability density.

Week 6: Expectations, moments, and moment generating function.

Week 7-8: Special probability distribution (discrete uniform, Bernoulli, binomial, geometric, negative binomial, hypergeometric, Poisson, multinomial, multivariate hypergeometric).

Week 9-10: Special probability densities (Uniform, exponential, gamma, chi-square, beta, and normal).

Week 11: Distribution function of random variables.

Week 12: Sampling distributions (distribution of sample mean and sample variance, central limited theorem, t-distribution, chi-square, F distributions).

Assignments, Midterm, and Final Exam:

RULE OF 48: You must collectively pass the midterm and final in order to calculate your final grade using the below listed grading scheme. Collectively pass means that the total of the midterm and final exam must be at least 30% out of 60% (20% midterm +40% final) of the final grade. If you do not achieve this, your maximum possible final grade will be 48%.

- Assignments 40%, due: September 27, October 11, October 25, November 15, November 29 (all on Friday)
- Midterm 20%, Thursday, October 31, in class
- Final exam 40%, TBA

This is a tentative schedule. The assignment due dates and test date are subject to change.

Expected Workload: For each lecture of 75 minute per and 2 lectures per week, students are expected to spend 3-6 hours out-of-class study time per week to go through and understand the lecture notes, complete assignments, and solve problems on their own. However, when encountering difficulties, I encourage students to seek help as earlier as possible without waiting to the last minute! Come to my office hours, TA's office hours, and statistical learning centre for help.

3 Course Resources

Text: There is no required textbook for this course, as the lecture note will serve as the primary resource for students. However, students are encouraged to access the following online textbooks or hard copies (and corresponding

chapters), available through the University of Guelph Library, as additional resources:

- John E Freund's *Mathematical Statistics with Applications*, 8th ed., by Miller & Miller, Pearson Eduction Canada.

Lecture Note: An (in)complete set of lecture notes is available from the bookstore for purchase in advance of lectures (hard copy or eBook). It is expected that students will bring a copy that can be completed during lectures. The Lecture Notes are not al- lowed to be re-distributed in any form.

Computer Software: The primary statistical software package that will be used in this course is R, which is freely available for download. Students are strongly encouraged to install R on their personal computers.

CourseLink: Course information and material (such as assignments, data sets, etc.) will be posted on CourseLink. Students are responsible to check the website regularly for updated information and announcements.

Scientific Calculators: Students are encouraged to have available a standard scientific calculator which is allowed for all exams. Graphing and programmable calculators are not allowed.

4 Course Policies

Every student is treated the same way according to the evaluation methods and the grading scheme. We will not modify style of tests and exam from in-person to online as this would not be fair to the other students.

Assignment Policies:

- Assignments are due 11:59pm on the due date. Please submit your assignment through the Gradescope.
- No late assignments will be accepted, and late or missed assignments will receive a grade of 0 automatically.
- Assignment will be marked by TA and returned through Gradescope. Therefore, queries on assignments should be presented to the TA.

- If you are under special or serious circumstance that you cannot submit your assignment, please contact me in email with your name, id number, within 48 hours before the due time (with supportive documents if applicable), the missed assignment percentage will go to your final exam.

- While you are encouraged to discuss approaches to assignment questions with other students, your submitted assignment must be your own work. Copying any part of another student's work is considered academic misconduct. (Please read the section on academic misconduct at the end of this document and in the undergraduate calendar.)

Midterm and Exam Policies: Midterm test will be held in class and therefore no student should have a conflict with the date or time. If a conflict does exist, it is your responsibility to resolve it immediately (e.g. athletic competition). When you find yourself unable to write the midterm please contact me in email with your name, id number, and supportive documents before the midterm, missed midterm percentage will be distributed to the final exam, or otherwise, no show on midterm will receive a grade of 0. There will be no makeup midterm test.

5 University Policies

Academic Integrity: The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the

academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is outlined in the Undergraduate Calendar:

Accessibility: The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 10 business days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.
More information: `www.uoguelph.ca/sas.`

Academic Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations.

Copies of Out-Of-Class Assignments: Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Drop Date: Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

Email Communication: As per university regulations, all students are required to check their ¡uoguelph.ca¿ e-mail account regularly: e-mail is the official route of communication between the University and its students.

Health and Wellbeing: The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness. If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources. The Student Wellness team are here to help and welcome the opportunity to connect with you.

Illness: Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

Recording of Materials: Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources: The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

When You Cannot Meet a Course Requirement: When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id number, and e-mail contact. See the Undergraduate Calendar for information on regulations

and procedures for Academic Consideration.