Lecture: Monday-Tuesday-Wednesday-Thursday, 1:30pm–3:10pm (Sec 01) / 9:50am–11:30am (Sec 02), online via Zoom. All lectures are recorded for later playback.

Instructor: Evan Dummit, Lake Hall 571, edummit@northeastern.edu.

Problem Sessions and Office Hours: Online via Zoom.

Course Webpage: https://web.northeastern.edu/dummit/teaching_su21_3081.html.

Course Textbook: The instructor will write lecture notes for the course (in lieu of an official textbook) as the semester progresses. The course will roughly follow Larsen and Marx's "An Introduction to Mathematical Statistics and its Applications" (5th edition), but it is not necessary to purchase the textbook.

Prerequisites: Math 1242 or 1252 or 1342 (Calculus 2). Math 3231 or 2323 (Calculus 3) is recommended, since some material in this course deals with multivariable integration.

Course Topics: Math 3081 is a calculus-based introduction to probability and statistics that covers the material primarily from a practical perspective, although we will adopt a more formal approach for certain aspects. Probability is the mathematical study of uncertainty and chance, and in addition to being worthy of study in its own right, it is also deeply linked to statistics, which concerns the analysis and interpretation of data.

Specifically, Math 3081 will cover probability distributions, conditional probability, independence, applications of probability, discrete and continuous random variables, joint distributions, expected value / variance / standard deviation, the binomial / exponential / Poisson / normal distributions and associated limit theorems, parameter estimation, maximum likelihood estimates, interval estimation, hypothesis testing, errors in hypothesis tests, z tests, the t distribution and Student's t test, and the χ^2 distribution and χ^2 tests for goodness-of-fit and independence. We will also spend substantial time discussing applications of hypothesis testing in the physical and social sciences, as well as the limitations and misuses of statistical methods.

Grades: Your course grade consists of **15% WeBWorK** and **85% exams**. There are four exams: three 75-minute midterms and a final. You may elect to take the 2-hour comprehensive final, covering material from the whole semester, or the 45-minute short final, covering only material after the third midterm.

If you select the comprehensive final: your score is the greater of (15% WeBWorK, 20% for each midterm, and 25% for the final) and (15% WeBWorK, 25% each of the top two midterms, and 35% for the final).

If you select the short final: your score is 15% WeBWorK, 23% for each midterm, and 16% for the final.

The homework score consists of your total WeBWorK points divided by the total number of problems assigned.

An overall raw score of 92% will be **at least** an A, 89% will be **at least** an A-, 86% will be **at least** a B+, 82% will be **at least** a B, 79% will be **at least** a B-, 76% will be **at least** a C+, 72% will be **at least** a C, and 69% will be **at least** a C-.

If you feel that an assignment or exam has been misgraded, please talk to the instructor directly. Requests for regrading will not be considered more than two days past the date the assignment or exam was returned.

Exams: There will be three 75-minute midterm exams, along with a 2-hour or 45-minute final exam.

If you miss an examination for any reason, you will receive a 0; make-up exams will not be given except at the instructor's discretion.

The midterms will be held on Saturdays in alternating weeks: July 17th (week 2), July 31st (week 4), and August 14th (week 6).

The final exam may be taken on either day of the final exam period: Mon August 23rd or Tue August 24th.

WeBWorK: WeBWorK is an electronic homework-assessment system that is free for students and has been designed specifically for courses in mathematics. Weekly WeBWorK assignments are due at 5am Eastern, typically on Fridays. **You are encouraged to consider the homeworks as being due "Thursday evening".**

It is highly recommended to start work on the assignments early, because some problems are quite lengthy. Many students like to work on the problems as soon as the corresponding material is covered in lecture. Do not fall into the trap of only starting the assignment the evening before it is due! **In particular, the midterm exams on Saturdays will cover the material on the WeBWorK assignment due immediately before.**

All problems on all assignments will be counted (no assignments or problems will be dropped), so you should do as much as you can on each assignment even if you cannot completely finish it. This is a summer course, and as such moves very quickly. Even a short delay in completing an assignment will make it very difficult for you to catch up; therefore, **WeBWorK extensions will be granted only in extreme circumstances, at the sole discretion of the instructor.**

Course Schedule: The course and lecture notes are organized into five chapters, as follows:

Weeks 1-2: Chapter 1 $\sim$ Counting and Probability: Sets and set operations, counting principles, permutations and combinations, probability, sample spaces and events, computing probabilities, conditional probability, independence of events, Bayes' formula, applications of probability.

Weeks 2-4: Chapter 2 $\sim$ Random Variables: Discrete random variables, expected value, variance, standard deviation, joint distributions and independence, the binomial and Poisson distributions, continuous random variables, uniform and exponential distributions, the normal distribution and central limit theorem, modeling applications of random variables.

Week 2: Midterm 1, covers chapter 1 and part of chapter 2.

Weeks 4-5: Chapter 3 $\sim$ Parameter and Interval Estimation: Parameter estimation, maximum likelihood estimates, biased and unbiased estimators, interval estimation.

Week 4: Midterm 2, covers portions of chapters 2 and 3.

Weeks 5-7: Chapter 4 $\sim$ Hypothesis Testing: Hypothesis tests, test statistics and p-values, one-sample and two-sample z tests, type I and type II errors, power, misinterpretations and misuses of hypothesis tests.

Week 6: Midterm 3, covers portions of chapters 3 and 4.

Weeks 6-7: Chapter 5 $\sim$ Topics in Hypothesis Testing: Student's t distribution, confidence intervals for μ, one-sample and two-sample t tests, the χ^2 distribution, confidence intervals for σ, the χ^2 tests for goodness-of-fit and independence.

Week 8: Final exam, covers all course material (comprehensive final) or chapter 5 (short final).

Collaboration Policy: You are free to use calculators and computer technology for homework problems, and calculators are allowed on exams.

Mathematics is fundamentally a collaborative endeavor, and discussing the course material with others is an excellent way to solidify your own understanding. In particular, you are allowed to work on, and discuss, homework assignments together, as long as the actual submissions are your own work.

A warning: it is critical not to outsource your learning! You cannot expect to retain knowledge if you do not solve your homework problems yourself, whether because you relied on other people to explain to you how to do the problems, or because you relied too heavily on technological assistance.

Please also note that 85% of your course grade is determined by the exams, on which collaboration is not allowed.

Attendance Policy: It is expected that you will attend every class. This course moves very fast, and it is quite possible to fall behind even if you only miss one day. If you miss class for any reason, it is highly advisable to consult the course lecture notes and to watch the recording of the lecture you missed. It is your responsibility to be aware of all information announced in class, including modifications to the course syllabus or schedule, even if you are absent.

If you will be absent from a class activity due to a religious observance or practice, or for participation in a university-sanctioned event (e.g., university athletics), it is your responsibility to inform the instructor during the first week of class and provide appropriate documentation if required.

Statement on Academic Integrity: A commitment to the principles of academic integrity is essential to the mission of Northeastern University. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University. Violations of academic integrity include (but are not limited to) cheating on assignments or exams, fabrication or misrepresentation of data or other work, plagiarism, unauthorized collaboration, and facilitation of others' dishonesty. Possible sanctions include (but are not limited to) warnings, grade penalties, course failure, suspension, and expulsion.

Statement on Accommodations: Any student with a disability is encouraged to meet with or otherwise contact the instructor during the first week of classes to discuss accommodations. The student must bring a current Memorandum of Accommodations from the Office of Student Disability Services.

Statement on Classroom Behavior: Disruptive classroom behavior will not be tolerated. In general, any behavior that impedes the ability of your fellow students to learn will be viewed as disruptive.

Statement on Inclusivity: Faculty are encouraged to address students by their preferred name and gender pronoun. If you would like to be addressed using a specific name or pronoun, please let your instructor know.

Statement on Evaluations: Students are requested to complete the TRACE evaluations at the end of the course.

Miscellaneous Disclaimer: The instructor reserves the right to change course policies, including the evaluation scheme of the course. Notice will be given in the event of any substantial changes.