APMA 1650 Fall21 Statistical Inference I

09/06/2021

Canvas website: **https://canvas.brown.edu/courses/1085735**
Class Hours: MWF 11-11:50am ET   Class Room: MacMillan Hall 117 & Zoom

Teaching team:

Instructor: Wenjun Zhao (`wenjun_zhao@brown.edu`)
Office: 182 George Street, Room 219   Office Hours: T 2-4pm

Graduate TAs: Anna Grim (`anna_grim@brown.edu`)
      Jake Mundo (`jake_mundo@brown.edu`)

Undergraduate TAs: Wesley Chiu (`po_wei_chiu@brown.edu`)
      Emma McFall (`emma_mcfall@brown.edu`)
      Shivani Mendiratta (`shivani_mendiratta@brown.edu`)
      Janet Qi (`janet_qi@brown.edu`)
      Anna Shi (`xiangkun_shi@brown.edu`)
      Justin Song (`justin_song@brown.edu`)
      Joanna Tasmin (`jtasmin@brown.edu`)
      William Yang (`william_yang@brown.edu`)

TA Office Hours/Locations: See Canvas for details

Course Description

APMA 1650 is an integrated first course in mathematical statistics. The first half of APMA 1650 covers probability and the last half is statistics, integrated with its probabilistic foundation. Specific topics include probability spaces, discrete and continuous random variables, methods for parameter estimation, confidence intervals, and hypothesis testing.

Materials

- Textbook: Mathematical Statistics with Applications 7th Edition, *by Dennis Wackerly, William Mendenhall, Richard L. Scheaffer*. Most of the first 10 chapters will be covered.

- Other helpful (all optional) resources:

    - A Modern Introduction to Probability and Statistics, by Frederik Michel Dekking, Cornelis Kraaikamp, Hendrik Paul Lopuhaä, Ludolf Erwin Meester (free e-book available through Brown University library).
    - Introduction to Probability, Statistics and Random Processes, by Hossein Pishro-Nik.
    - Statistics and probability, by Khan Academy.

Prerequisites

One year of university-level calculus. At Brown, this corresponds to MATH 0100, MATH 0170, MATH 0180, MATH 0190, MATH 0200, or MATH 0350. A score of 4 or 5 on the AP Calculus BC exam is also sufficient.
* Previous exposure to multivariable calculus is also helpful (but not required). *

Grading Policy

The grade will count the assessments using the following proportions:

- **40%** of your grade will be determined by 9 weekly assignments.

- **30%** of your grade will be determined by two midterm exams (15% each). They are tentatively scheduled on Oct 13 and Nov 17.

- **30%** of your grade will be determined by the cumulative final exam, tentatively scheduled on Dec 17.

In accordance with Brown's grading system, ABC/NC or S/NC grades will be **tentatively** assigned based on the following cutoffs:

- **ABC/NC**: 90%-100% (A), 75%-89% (B), 60%-74% (C), 0%-60% (NC).

- **S/NC**: 60%-100% (S), 0%-60% (NC).

*Note that I reserve the right to adjust the grades or cutoffs slightly. *

Course Policies

Required technology (all accessible through canvas)

- **Zoom:** course video/audio communication during synchronous meetings and office hours.

- **Media library:** class/recitation recordings.

- **Gradescope:** assigning/grading weekly assignments and exams.

- **Ed discussion:** posting questions and getting answers from instructors.

Policies on Assignments

- Problem sets will be posted on Canvas about one week in advance of the due date (every Friday). The assignments will be submitted via Gradescope (accessible on Canvas). You can submit regrading requests through Gradescope if you disagree with the released grades.

- Late assignments will not be accepted unless a valid excuse (illness/emergency) is communicated to the instructor with verification. Any requests for late deadlines or late assignments should be directly emailed to the instructor. TAs can not grant homework extensions.

- You are encouraged to discuss the problems in the homework with your classmates, however you are supposed to independently write up your own solution. Students who are suspected of copying part of an assignment will receive a zero on the assignment and may be referred to the Case Administrator of the Academic Code. You are supposed to report the names of your collaborators on the top of every assignment.

Academic Integrity and Honesty

Students are required to comply with the university policy on academic integrity. Please see Brown's Academic code for details. Students who are suspected of violating the Academic Code will may be reported to the Case Administrator of the Academic Code.

Accommodations for Disabilities

Brown University is committed to full inclusion of all students. Please inform me early in the term if you may require accommodations or modification of any of course procedures. You may speak with me after class, during office hours, or by appointment. If you need accommodations around online learning or in classroom accommodations, please be sure to reach out to Student Accessibility Services (SAS) for their assistance (seas@brown.edu, 401-863-9588). Students in need of short-term academic advice or support can contact one of the academic deans in the College.

Books, Supplies, and Materials

If your Brown undergraduate financial aid package includes the Book/Course Material Support Pilot Program (BCMS), concerns or questions about the cost of books and course materials for this or any other Brown course (including RISD courses via cross-registration) can be addressed to bcms@brown.edu. For all other concerns related to non-tuition course-related expenses, whether or not your Brown undergraduate financial aid package includes BCMS, please visit the Academic Emergency Fund in E-GAP (within the umbrella of "E-Gap Funds" in UFunds) to determine options for financing these costs, while ensuring your privacy.

Class Recording and Distribution of Course Materials

The course will be presented in a hybrid mode: the lectures will be held in person while synchronously live-streamed over Zoom. The recordings will be posted for students that are enrolled but cannot be present. Lectures and other course materials are copyrighted. Students are prohibited from reproducing, making copies, publicly displaying, selling, or otherwise distributing the recordings or transcripts of the materials. The only exception is that students with disabilities

may have the right to record for their private use if that method is determined to be a reasonable accommodation by Student Accessibility Services. Disregard of the University's copyright policy and federal copyright law is a Student Code of Conduct violation.

Schedule

- Week 1 (Sept 8, 10) Introduction to statistics, basic definitions of probability (§1, 2.1-2.4).

- Week 2 (Sept 13, 15, 17) Set theory, combinatorics, conditional probability (§2.3-2.7).

- Week 3 (Sept 20, 22, 24) Independence, multiplicative law, law of total probability, Bayes' law, discrete random variables (§2.7-2.11, 3.1-3.3). **Assignment 1 Due**

- Week 4 (Sept 27, 29, Oct 1) Expectations, binomial distribution, geometric distribution, hypergeometric distribution (§3.3-3.5, 3.7). **Assignment 2 Due**

- Week 5 (Oct 4, 6, 8) Poisson distribution, moments, moment-generating function, Markov's inequality, Tchebysheff's theorem (§3.8, 3.9, 3.11). **Assignment 3 Due**

- Week 6 (Oct 13, 15) Introduction to continuous random variables (§4.1-4.2). **Midterm 1**

- Week 7 (Oct 18, 20, 22) Expected values, uniform distribution, normal distribution, Gamma distribution, Beta distribution (§4.2-4.7). **Assignment 4 Due**

- Week 8 (Oct 25, 27, 29) Other expected values, Tchebysheff's theorem, multivariable calculus, multivariate distributions (§4.9-4.10, 5.1-5.2). **Assignment 5 Due**

- Week 9 (Nov 1, 3, 5) Marginal and conditional probability, independence, expected values, covariance, statistics of linear combinations (§5.3-5.8). **Assignment 6 Due**

- Week 10 (Nov 8, 10, 12) Multinomial and bivariate normal distributions, conditional expectations, functions of random variables, order statistics, CLT (§5.9-5.11, 6, 7). **Assignment 7 Due**

- Week 11 (Nov 15, 17, 19) Point estimators, bias, mean square error, consistency (§8.1-8.3, 9.3). **Midterm 2**

- Week 12 (Nov 22) Method of moments, MLE (§9.6, 9.7).

- Week 13 (Nov 29, Dec 1, 3) Confidence interval, large/small sample CIs for expectation, hypothesis test (§8.5, 8.6, 8.8, 8.9, 10.1-10.3). **Assignment 8 Due**

- Week 14 (Dec 6, 8, 10) Hypothesis test (§10.4-10.6). **Assignment 9 Due**

- **Final exam** (Dec 17)