STAT 512 A Au 23: Statistical Inference

Jump to Today Edit

The Team:

Instructor: Ema Perković;

TAs: Zhenman Yuan; Harshil Desai;

We will be using Ed Discussion for class discussion.

Please only send emails to discuss sensitive information.

Class Times	**Time**
Lecture	MWF 10:30 AM - 11:20 AM at SAV 264
Quiz section	W 12:30 – 1:20 PM at DEM 104

Office Hours

Ema Perkovic: W 4:00 PM - 5:00 PM.

TA:

Zhenman Yuan: Mon 3:30-4:30PM

Harshil Desai: Tu 12:30-1:30 PM

Main textbook:

- Yen-Chi Chen's lecture notes (YCC) and,
- Statistical Inference (Second Edition, 2002) by G. Casella and R. Berger (CB)Links to an external site.
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- Additionally, Michal D. Perlman's lecture notes (MDP).Links to an external site.
- Useful background:
  - Mathematical Methods for Physics and Engineering (2006)Links to an external site.
    , K. F. RileyLinks to an external site.
    , M. P. HobsonLinks to an external site.
    , S. J. BenceLinks to an external site.
- Theory exam study guide Download Theory exam study guide

, compiled by former students, contact senior students for a possible updated version.

- Other useful readings:
  - Multivariate Analysis by Mardia, Kent, and Bibby (1980)
  - Mathematical statistics: basic ideas and selected topics (2015) by P. J. Bickel & K. A. Doksum.
  - All of statistics: a concise course in statistical inference (2013) by L. Wasserman.

Course Description: STAT 512-513 will cover much of the "classical" theory of statistical inference (but not all; for example, the theory of linear models is mainly treated in BIOSTAT/STAT 533/570.) We will begin with
a brief review of univariate probability (CB Chapters 1, 2, and 3), then move to bivariate and multivariate
distributions, especially the multinomial and multivariate normal distributions (CB Ch. 4-5). This should occupy the first 7-8 weeks (approximately.) The remainder of 512 and 513 will cover CB Ch. 5-8, 10, and possibly part of 9: topics include properties of random samples, limit theorems and asymptotic distributions, propagation of error (= delta method = first-order Taylor expansion), sufficient statistics, estimation theory including maximum likelihood estimation, unbiased estimation, nonparametric estimation, and large sample
properties of estimators, elementary decision theory, and hypothesis testing, including likelihood ratio and chi-square tests, and Bayesian inference. (Linear models and regression, the topics of the final two chapters of CB, are covered in 533/570.)

Prerequisites: Multivariable calculus (limits, infinite series, partial derivatives, and multiple integrals). Linear algebra (vectors, matrices, determinants, inverses, Cauchy-Schwartz inequality, orthogonal and positive definite matrices, eigenvalues). Some familiarity with elementary probability theory, e.g., probability distributions, expected values, random variables, and conditional probability (Math/Stat 394-5).

Grading policy and exams:

All assignments will be graded through Gradescope

. Please upload your solutions there.

- Participation (10%): Notes, 9 weekly assignments - your notes from the lectures and on pre-specified topics from the lecture notes. Each set is worth 2 points. If late or incomplete (some topics not covered enough), 1 pt.
- Homework (45%). Weekly - 7 in total; submitted in groups of 2-3; need to specify your group mates,
- Midterm (15%): in-person, closed book, **1-page (letter or A4 sized)** cheat sheet allowed. **See the schedule for the date.**
- Final (30%): in-person, closed book, **1-page (letter or A4 sized)** cheat sheet

allowed. **See the schedule for the date.**

Format of HW: There will be 7 homework assignments. The homework will be released on Wednesday and be due at the end of next Wednesday at 11:59:59PM Seattle Time. You need to submit your answers in the format of a PDF file that is typed by LATEX or R-markdown and upload them to Gradescope. Homework turned in late will be penalized by 0.8*x, where x is the days of late submission, rounding to the smallest integer greater or equal to x when $x \leq 3$. Namely, if you are late for 10 minutes, the total score will be multiplied by 0.8. If you are late for one day and 20 minutes, the total score will be multiplied by 0.8*2 = 0.64. Late for more than 3 days will receive 0 points.

Course contents:

Notes and Schedule page

• **Topic 1: Introduction to probability and statistics (week 1)**. – sample space and probability measures, random variables, common distributions, conditionals, independence, Bayes theorem

• **Topic 2: Transforming continuous random variables (week 2).** – one function of one random variable, one function of two or more random variables, exponential distribution, and memoryless properties.

• **Topic 3: Expectation and basic convergence theories (week 2-3)**. – expectation, moment generating functions, convergence theory, weak law of large numbers, central limit theorem, concentration inequality, Hoeffding's inequality.

• **Topic 4: Conditional expectation and conditional distribution (week 4).** – conditional distribution for mixed random variables, conditional expectation, law of total expectation, law of total variance, inverse probability weighting

• **Topic 5: Correlation, prediction, and regression (week 5)**. – correlation, mean-square error prediction, linear prediction, best linear predictor, multivariate linear predictor, classification

• **Topic 6: Estimators (week 6).** – maximal likelihood estimator, method of moments, empirical risk minimization, Bayes estimator (posterior mean and maximum a posteriori)

• **Topic 7: Multinomial distribution (week 7).** – multinomial distribution, conditionals in multinomials, exponential family, Bernoulli representation of multinomials

• **Topic 8: Linear models and the multivariate normal distribution (week 7-8).** – review of matrix, the Jacobian method, polar coordinate, random vector and covariance matrix, multivariate normal distributions, chi-square distributions, non-central chi-square distributions

• **Topic 9: Order statistics (week 9).** – order statistics, Beta-binomial relation,

spacings in uniform random variables

• **Topic 10: Asymptotic theories and statistical functionals (week 9-10).** – statistical functions, consistency, empirical distribution function, plug-in estimate, the delta method, variance-stabilizing transformations, asymptotic theory of sample covariance matrix, asymptotic theory of quantiles, asymptotic efficiency

Access and Accommodations:

Your experience in this class is important to me. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so we can discuss how they will be implemented in this course.

If you have not yet established services through DRS but have a temporary health condition or permanent disability that requires accommodations (conditions include but are not limited to mental health, attention-related, learning, vision, hearing, physical, or health impacts), contact DRS directly to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Contact DRS at disability.uw.edu

Links to an external site.
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Academic Integrity:

Collaboration and discussions are allowed and encouraged in this class, but copying or letting others copy your work amounts to plagiarism. This includes copying model solutions, e.g., from prior years. Although cheating seldom occurs in graduate classes, if it does, I will take the following action: assign a grade of 0.0 for the exam/homework where the cheating occurred and **report the incident to the Graduate School Committee on Academic Conduct**, which will decide upon an appropriate University course of action.

Religious Accommodations:

Washington state law requires that UW develop a policy for the accommodation of student absences or significant hardship due to reasons of faith or conscience or for organized religious activities. The UW's policy, including more information about requesting an accommodation, is available at the Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).

Student conduct:

Follow the UW Student Conduct Code in your interactions with your colleagues and me in this course by respecting the many social and cultural differences among us, which may include, but are not limited to, age, cultural background, disability, ethnicity, family status, gender identity and presentation, citizenship and immigration status, national origin, race, religious and political beliefs, sex, sexual orientation, socioeconomic status, and veteran status.