

Statistics 4301

Advanced Statistical Inference

3-semester-hour course

Prerequisite: Stat 3201 and Stat 3202; or Stat 4201 and Stat 4202; or permission of the instructor.

Class distribution: Three 55-minute lectures per week

Course Description and Learning Outcomes: The course will cover advanced probability models and fundamentals of inferential procedures.

Upon successful completion of the course, students will be able to

1. Quantify the probability of events using mathematical description of probability
2. Learn the properties of probability mass/density and cumulative distribution functions.
3. Quantify probability models through their moments and moment generating functions
4. Derive the probability distribution of transformed random variables
5. Derive the probability distribution of order statistics
6. Formulate, construct and interpret confidence intervals of the parameters in a statistical model
7. Formulate statistical hypotheses about the parameters in a statistical model, construct appropriate hypothesis tests, understand the properties of such tests, and interpret the results in both a statistical and practical context
8. Conduct distribution-free hypotheses testing procedures

Required Text and Other Course Material

The required text book for the course is Probability and Statistics, 4th edition, by Morris H. DeGroot and Mark H. Schervish (Pearson, ISBN: 978-0321500465)

Assignments

Homework will be assigned (approximately) weekly, will be due on the dates announced in class, and will be graded. Assignments will consist of problems from the textbooks or from other sources to reinforce learning the material covered in the lectures.

Exams

There will be two in-class midterm exams that cover the material from lectures, the assigned readings and homework. A final examination will be given during the university's examination period.

Grading Information

The final grade will be assigned based on homework assignments, two in-class midterm exams and a comprehensive final examination. The weights of each component of the grade are

Homework	Midterm 1	Midterm 2	Final Exam
20%	25%	25%	30%

Outline of Topics

- 1) Review of probability
- 2) Review of basic statistical distributions
- 3) Conditional probability
 - a. Conditional and marginal distributions
 - b. Bayes Theorem
- 4) Functions of random variables
 - a. Order statistics
 - b. Function of random variables: distribution function technique
 - c. Transformation technique: one variable
 - d. Transformation technique: two variables
 - e. Moment generating function technique
- 5) Review of expected values, moments
 - a. Conditional expectation
 - b. Moment generating functions
 - c. Product moments
 - d. Moments of linear combination of random variable
- 6) Large sample theory
 - a. Convergence in probability
 - b. Law of large numbers
 - c. Central limit theorem
 - d. Issues in sampling from finite populations
- 7) Estimation
 - a. Maximum likelihood
 - b. Sufficiency
 - c. Bayesian estimation
- 8) Hypothesis testing
 - a. Testing simple hypotheses, Neyman-Pearson Lemma
 - b. Likelihood ratio tests
 - c. Uniformly most powerful tests
 - d. Bayesian testing
- 9) Nonparametric Statistics
 - a. Signed rank test
 - b. Rank-sum test

Statement on Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

Special Accommodations

Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614- 292-3307, slds@osu.edu; slds.osu.edu.