Course Information for STAT:7200 "Linear Models"
The University of Iowa
The College of Liberal Arts and Sciences
Fall 2025

Instructor

Dale Zimmerman, a.k.a. "Dr. Z," 217 Schaeffer Hall, Office phone 5-0818, Home phone 351-0520, E-mail dale-zimmerman@uiowa.edu

Class Hours and Location

Our class will meet in 75 SH on Mondays and Wednesdays, 8:30 – 10:20 am.

Office (Drop-in) Hours

Conducted in person at 1:00 – 2:00 pm Tuesdays and 1:00 – 3:00 pm Thursdays (except Sept. 18 and Oct. 9), or by appointment.

Department Information

Department of Statistics and Actuarial Science, 241 Schaeffer Hall, Phone 335-2082, Webpage www.stat.uiowa.edu

Department Executive Officer

Professor Kung-Sik Chan, 241 SH, Phone 335-0712, E-mail kung-sik-chan@uiowa.edu

Student Complaints

Students with a complaint about a grade or a related matter should first discuss the situation with the instructor and/or the course supervisor (if applicable), and finally with the DEO (Chair) of the department, school or program offering the course. Sometimes students will be referred to the department or program's Director of Undergraduate Studies (DUS) or Director of Graduate Studies (DGS).

Undergraduate students should contact CLAS Undergraduate Programs for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS Graduate Affairs Manager when additional support is needed.

Course's College (Administrative Home)

The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the policies and procedures for its courses. Graduate students, however, must adhere to the academic deadlines set by the Graduate College.

Drop Deadline for this Course

You may drop an individual course before the drop deadline; after this deadline you will need collegiate approval. You can look up the drop deadline for this course here. When you drop a course, a "W" will appear on your transcript. The mark of "W" is a neutral mark that does not affect your GPA. To discuss how dropping (or staying in) a course might affect your academic goals, please contact your Academic Advisor. Directions for adding or dropping a course and other registration changes can be found on the Registrar's website. Graduate students should adhere to the academic deadlines and policies set by the Graduate College.

UI Email

Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community. For the privacy and the protection of student records, UI faculty and staff can only correspond with UI email addresses.

Textbook

The textbook for the course is *Linear Model Theory: With Examples and Exercises*, by Dale L. Zimmerman, published by Springer in 2020. Readings will be assigned from this book. An e-version of the book is available, free of charge, to all University of Iowa students. With one exception, the book is self-contained, so there is no need to do any reading outside of it. The exception is background material on matrix algebra useful for linear models; for this, frequent reference will be made to *Matrix Algebra from a Statistician's Perspective*, by David A. Harville (Springer). Purchasing this book is recommended because it will be a good resource for relevant matrix algebra results over the course of your career as a student and statistician, but it is not required because no reading will be assigned from it.

There is also available a companion book of solutions to the textbook's exercises, which is *Linear Model Theory: Exercises and Solutions*, by Dale L. Zimmerman, published by Springer in 2020.

Course ICON Site

To access the course site, log into Iowa Courses Online (ICON) using your Hawk ID and password.

Exams

- 2 two-hour, in-class, midterm exams; the first will be given in class on October 8 and the second will be given in class on November 19. These two exams are "closed-book," except that Dr. Z will provide copies of Chapters 1–4 to each student for use during both exam periods.
- 1 two-hour, in-class, final exam, taken during our assigned final exam period, the time and place of which is not yet determined.

Lectures

Course lectures will feature some material from the textbook and some solutions to exercises in the textbook. In addition, some examples and exercises (and their solutions) not in the textbook may be presented.

Homework

Written assignments are an *essential* component of the course. Assignments generally consist of 8 or so exercises, some of which have multiple parts, and will be given at intervals of approximately 10-14 days. They may take considerable time to complete, so it is best to start the exercises as soon as we have covered the relevant material in lecture. Completed assignments should be turned in at the beginning of class on the day they are due. Unless prior arrangements are made, late homework will receive a score no higher than 50%. Students may work on homework problems together, provided that no outright plagiarism occurs. Dr. Z is more than willing to provide homework help during office hours and/or to

give hints/guidance by email at any time.

Attendance
Attendance at lectures and participation in discussions are expected. Failure to attend class regularly will adversely affect your grade, and no help will be offered on homework problems requiring material in class that you miss (unless you have a valid excuse).

Grading

- Homework, 25%
- Midterm exams, 50% (25% each)
- Final exam, 25%

A plus-minus grading system will be used. In the past, all students who have achieved a percentage of 50% or higher on exams have earned at least a B- grade, and all who have achieved a percentage of 75% or higher on exams have earned at least an A- grade. Scores on homeworks and exams will be entered into a gradebook on the course ICON site, which you can log into using your Hawk ID and password.

Course Learning Objectives

1. To acquire a rigorous understanding of the theory underlying statistical applications of linear models (regression, ANOVA, BLUE, multiple comparisons, BLUP, variance component estimation, etc.).
2. To become equipped to read journal articles and begin thesis research, possibly on some topic that overlaps with linear models.

Not a Course Objective
To learn how to analyze data or become familiar with "linear models methods" for data analysis and interpretation through the use of statistical computing packages.

Course Topics

1. Matrix preliminaries, e.g., basic results on vector spaces, linear independence, transposes, ranks, inverses, eigenvalues and eigenvectors; traces, determinants, nonnegative definite and positive definite matrices, optimization of functions of many variables
2. Generalized inverses and systems of linear equations
3. Expectations, variances, and covariances of linear and quadratic forms
4. Types of linear models
5. Estimability and unbiasedness
6. Ordinary least squares for classical (fixed-effects, unconstrained) linear models: Gauss-Markov Theorem, reparameterizations, orthogonal projections, algebraic and geometric structure of the analysis of variance, partitioning the ANOVA

7. Constrained least squares estimation
8. Generalized least squares
9. Model misspecification and its consequences
10. Best linear unbiased prediction (BLUP), random and mixed linear models
11. Multivariate normal, noncentral chi-square, noncentral F and t distributions
12. Distributions of linear and quadratic forms; independence of quadratic forms; Cochran's Theorem
13. Hypothesis testing, confidence intervals and regions, simultaneous confidence intervals and multiple comparisons
14. Estimation of variance components, including maximum likelihood and restricted maximum likelihood (REML) approaches
15. Empirical BLUE/BLUP

Academic Honesty and Misconduct
All students in CLAS courses are expected to abide by the college's standards of academic honesty. Undergraduate academic misconduct must be reported by instructors to CLAS according to these procedures. Graduate academic misconduct must be reported to the Graduate College according to Section F of the Graduate College Manual.

Artificial Intelligence (AI) Policy
Students are free to use AI when solving homework problems, but it will not be available for use on exams.

Making a Suggestion or a Complaint
Students with a suggestion or complaint should first visit the instructor, then the course supervisor, and then the departmental DEO. Complaints must be made within six months of the incident. See the CLAS Student Academic Handbook.

Accommodations for Students with Disabilities
The University of Iowa is committed to providing an educational experience that is accessible to all students. A student may request academic accommodations for a disability (which include but are not limited to mental health, attention, learning, vision, and physical or health-related conditions). A student seeking academic accommodations should first register with Student Disability Services and then meet with the course instructor privately in the instructor's office to make particular arrangements. Reasonable accommodations are established through an interactive process between the student, instructor, and SDS. See `http://sds.studentlife.uiowa.edu/` for more information.

Absences from Class
University regulations require that students be allowed to make up examinations which have been missed due to illness, religious holy days, military service obligations, including

service-related medical appointments, jury duty, or other unavoidable circumstances or other university-sponsored activities. Students should work with their instructors regarding making up other missed work, such as assignments, quizzes, and classroom attendance.

Absences for Religious Holy Days

The university is prepared to make reasonable accommodations for students whose religious holy days coincide with their classroom assignments, test schedules, and classroom attendance expectations. Students must notify their instructors in writing of any such religious holy day conflicts or absences within the first few days of the semester or session, and no later than the third week of the semester. If the conflict or absence will occur within the first three weeks of the semester, the student should notify the instructor as soon as possible. See Policy Manual 8.2 Absences for Religious Holy Days for additional information.

Absences for Military Service Obligations

Students absent from class or class-related requirements due to U.S. veteran or U.S. military service obligations (including military service–related medical appointments, military orders, and National Guard Service obligations) shall be excused without any grading adjustment or other penalty. Instructors shall make reasonable accommodations to allow students to make up, without penalty, tests and assignments they missed because of veteran or military service obligations. Reasonable accommodations may include making up missed work following the service obligation; completing work in advance; completing an equivalent assignment; or waiver of the assignment without penalty. In all instances, students bear the responsibility to communicate with their instructors about such veteran or military service obligations, to meet course expectations and requirements.

Free Speech and Expression

The University of Iowa supports and upholds the First Amendment protection of freedom of speech and the principles of academic and artistic freedom. We are committed to open inquiry, vigorous debate, and creative expression inside and outside of the classroom. Visit the Free Speech at Iowa website for more information on the university's policies on free speech and academic freedom.

Non-discrimination Statement

The University of Iowa prohibits discrimination in employment, educational programs, and activities on the basis of race, creed, color, religion, national origin, age, sex, pregnancy (including childbirth and related conditions), disability, genetic information, status as a U.S. veteran, service in the U.S. military, sexual orientation, gender identity, or associational preferences. The university also affirms its commitment to providing equal opportunities and equal access to university facilities. For additional information on nondiscrimination policies, contact the Senior Director, Office of Civil Rights Compliance, the University of Iowa, 202 Jessup Hall, Iowa City, IA 52242-1316, 319-335-0705, ui-ocrc@uiowa.edu. Although not required, students have the option to share their pronouns and chosen/preferred names in class and through MyUI. Instructors and advisors can find information about a student's chosen/preferred name in MyUI.

Classroom Expectations

Students are expected to comply with University policies regarding appropriate classroom

behavior as outlined in the Code of Student Life. While students have the right to express themselves and participate freely in class, it is expected that students will behave with the same level of courtesy and respect in the virtual class setting (whether asynchronous or synchronous) as they would in an in-person classroom. Failure to follow behavior expectations as outlined in the Code of Student Life may be addressed by the instructor and may also result in discipline under the Code of Student Life policies governing E.5 Disruptive Behavior or E.6 Failure to Comply with University Directive.

For the UI policy regarding severe weather, see https://opsmanual.uiowa.edu/community-policies/extreme-weather-protocol

For policies on sexual harassment and other items, see https://provost.uiowa.edu/student-course-policies