STAT:3210 Experimental Design & Analysis Spring 2023

Class Meeting: MWF 11:30am–12:20pm 427 EPB

Instructor: Dr. Erning Li, 231 SH, 335-0820, *erning-li@uiowa.edu*

Office hours: Mon & Wed 10:00–11:00 am, Fri 12:40–1:40 pm; and by appointment.

Grader: Yiran Zeng, *yiran-zeng@uiowa.edu*

Department Information: Department of Statistics and Actuarial Science, 241 SH, 335-2082.
DEO: Professor Kung-Sik Chan, 241 SH, 335-0712, *kung-sik-chan@uiowa.edu*

Prerequisite: STAT:3200 and prior exposure to basic use of statistical programming software R.

Course Description and Objective: This course emphasizes practical aspects of experimental design and analysis. Both design and analysis of experiments as well as statistical computing (primarily R) are discussed. At the end of the semester, students should understand the principles, models and strategies commonly used for experimental design and data analysis, and be comfortable planning and analyzing experiments.

Main coverage: Basic principles of experimental design; Randomization; Completely randomized design; Paired design; Randomized blocks, Latin Squares, Greco-Latin Squares and related designs; Factorial design; Blocking in factorial design; 2^k factorial design; Extension of 2^k factorials; Blocking and confounding in 2^k factorials; Partial confounding; Fractional factorial designs; Blocking in fractional factorials; Nested and split-plot designs; Replicated and un-replicated designs; Regression, ANOVA, and follow-up analysis; Power calculation; Sample size determination; Relative efficiency; Response surface; Random effects model.

ICON Course Website: Course materials including syllabus, lecture notes, homework assignments, grades, answer keys, etc. will be posted on ICON `https://icon.uiowa.edu/`.

Communication: UI Email—have your UI email address in the class roster and use it when corresponding with me via email (state the course number or title in your email). Important announcements to the class will be emailed via the ICON class roster.

Lecture Notes: My lecture notes is a "mini textbook" for the class. They are posted on ICON in advance and will be intensively used in lectures and assignments. Students are strongly recommended to diligently take additional notes in class.

Reference Book (recommended but not required):

Montgomery, D. C., *Design and Analysis of Experiments*, 9th edition, Wiley.

R Software: R computing is taught and used throughout the semester.

R is open-source statistical software—one of the most popular and powerful for data analysis. It is freely available at *https://www.r-project.org/* and can be downloaded to personal computer for free use. It is also available on the university Virtual Desktop and at the Instructional Technology Centers (ITCs) such as 41 SH. See a review of R in ICON.

Regular Homework: Regular homework will be assigned periodically in ICON; mostly week-long assignments. Students will turn in their assignment using file upload in ICON by its due date and time. Please submit your homework in Word doc, pdf files, or clear, readable scans/images of reasonable size. Please double check your submission each time, as points will be deducted if submission cannot be opened or read, or has missing pages. All regular homework assignments are essential, vital practices and will be counted towards overall grade.

Unless prior or prompt arrangements are made for reasons judged to be acceptable by Dr. Li, homework turned in after it is due will receive 0 (zero) credit. Additionally, as answer keys will be posted soon after an assignment is graded, late homework submission will only be considered in exceptional circumstances and with prior or prompt notification.

Students are allowed to discuss homework assignments, but everyone should write up their own individual answers and do their own individual calculations and programming/computing. If "blind copying" in a student's answer sheets is identified, all involved students will receive zero score and be considered as plagiarism. Discussions among students can be posted on the ICON Discussion Boards; notice that Discussion Board posts are public that everyone in the class will be able to read all of the posts and responses, and respond to them.

Exams:

Midterm Exam 1	**Friday, March 3** in class
Midterm Exam 2	**Monday, April 17** in class
Final Exam	**TBD by the University**

You can bring one standard letter-size (8.5in $\times$ 11in like regular printer paper) sheet of paper with anything you want written or typed on both sides to each midterm exam, and three such self-prepared help sheets to the final exam. Also bring a scientific calculator (any type) to each exam. Other than these, all exams are closed-book and closed-notes.

Any unexcused absence from an exam will result in a score of zero with no opportunity for a makeup. A makeup exam (different but equivalent to the original) will be considered only with documentation of reasons required by the university policy and under prior or prompt arrangement made with Dr. Li, and it should be scheduled as soon as possible.

All exams and makeups are in-person and proctored. These exam rules apply to all exams and makeups.

The midterm exams are given at regular class meeting times. The final examination date and time will be announced by the Registrar generally by the fifth week of classes. It is your responsibility to know the date, time, and place of the final exam.

Grading: A numerical final score on the scale of 0 to 100 will be determined according to the following (tentative) breakdown

Homework	16%
Midterm 1	26%
Midterm 2	26%
Final	32%

Conversion of these scores into letter grades will be made according to the following scale:

$$[90, 100] \text{ A}; \quad [80, 90) \text{ B}; \quad [67, 80) \text{ C}; \quad [50, 67) \text{ D}; \quad < 50 \text{ F}.$$

At the discretion of Dr. Li, depending on class performance and participation, these ranges may be adjusted, but only downward - criteria will only become easier, not harder.

Plus (+) and minus (-) gradings will be given as deemed appropriate. A+ grade will be used only to indicate rare and extraordinary academic achievement.

Integrity of Course Materials: I request that you preserve the integrity of the course materials. This means that under no circumstance should you make public (either in print or via web postings, social networks, etc.) or disseminate any course materials such as lecture notes, handouts, assignments, exams, solutions, recordings, as well as other materials that I prepare. You must also strive to avoid making use of any solutions provided by anyone outside of this class. Compliance with this request will be considered part of the academic honesty requirements discussed further below under Administrative Policies.

Participation and Classroom Environment: Participation in course activities is very vital to your success in this course. Regular attendance is expected and roll may be taken on random days. Students who are absent from class without acceptable excuse should not seek help regarding missed lectures during my office hours.

When in class, please refrain from talking on cell phones, texting, using laptops/tablets (if not for note-taking purpose), and prolonged conversation with a fellow student. Wireless-capable devices such as laptops, tablets, smart phones, etc. must be put away during exams.

Topics:

1. Introduction - basic principles of experimental design

   Why and how to conduct randomization

2. Comparative experiments and analysis

   Fundamental power calculation and sample size determination

3. Single-factor experiments and analysis

   Power calculation and sample size determination in Complete Randomized Design

4. Randomized Complete Block Design and analysis

   Types of sums of squares

   Power calculation and sample size determination in Randomized Complete Block Design

5. Latin Squares Design and analysis

6. Factorial Design and analysis

   Power calculation and sample size determination in Factorial Design

7. 2^k Factorial Design and analysis

8. Blocking 2^K Factorial Design and analysis

9. Fractional Factorial Design and analysis

10. Split-plot Design and analysis

Academic Honesty and Misconduct

All students in CLAS courses are expected to abide by the CLAS Code of Academic Honesty.

Student Complaints

Students with a complaint about a grade or a related matter should first discuss the situation with the instructor, and finally with the Director or Chair of the school, department, or program offering the course.

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 Associate Dean for Graduate Education and Outreach and Engagement when additional support is needed.

Drop Deadline for this Course

You may drop an individual course before the 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. Directions for adding or dropping a course and other registration changes can be found on the Registrars website. Undergraduate students can find policies on dropping and withdrawing here. Graduate students should adhere to the academic deadlines and policies set by the Graduate College.

University Policies

Accommodations for Students with Disabilities

Basic Needs and Support for Students

Classroom Expectations

Exam Make-up Owing to Absence

Free Speech and Expression

Mental Health

Military Service Obligations

Non-discrimination

Religious Holy Days

Sexual Harassment/Misconduct and Supportive Measures

Sharing of Class Recordings