



**ISE 610 Advanced Design of Experiments
and Quality Engineering
Fall 2023**

Units: 4

Time & Location: MW 2-3:50PM @ KAP 156

Instructor: Prof. Q. Huang

Office: GER 216C

Office Hours: Monday 4-5PM

Contact Info:

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Office Hours: Thursday 4-5PM @ GER 242B

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Course Description

This course will introduce methodology of design of experiments for efficient data collection and causal inference with wide scientific and engineering applications.

Learning Objectives

- Identify the goal of design of experiments for causal inference.
- Define the basic terminology and concepts of experimental design.
- Define the common procedure of experimental design.
- Identify different types of experimental designs.
- Select proper design of experiments through identification of experimental objectives.

Course Notes

- This course will be graded in letter.
- Lecture slides and other class information will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required

Using statistical software is mandatory in your class project and some of your homework assignments. At your convenience, you could choose R or Python. A powerful statistical software R, which is free for download at www.r-project.org, will be demonstrated for problem solving in the class. PhD students are strongly recommended to use R.

Readings

Required textbook: Wu & Hamada, Experiments: Planning, Analysis and Optimization, 2021, John Wiley, Third edition. (ISBN: 978-1-119-47010-6)

Chapters 1 & 2: A First Course in Causal Inference, Peng Ding, UC Berkley Statistics, <https://arxiv.org/abs/2305.18793>

Supplemental reading materials: Design and Analysis of Experiments, 9th Edition, by Douglas C. Montgomery, Wiley. (ISBN-13: 978-1119386100)

Description and Assessment of Assignments

There will be homework assignments for each chapter and a semester-long class project. For the class project, please form a team of two or three students. In the final project report, all team members should sign and state that they contribute to their project roughly equally. Every member will receive the same grade on the project.

The report should be typewritten and printed out for handing in. The report should not exceed 20 pages. (12-point, double space, Appendix does not count to 20 pages.) The report must have a professional appearance. Clarity and thoroughness of the analysis, and good use of the English language, including grammar, spelling, and punctuation, are considered in grading the project.

Final project report includes project objective, problem statement, solutions, conclusions, and appendix if needed. The report should describe the background, any assumptions made, the analysis used to analyze the data, and the appropriate results. Explanation, interpretation, and justifications are required. Computer output should be included in an appendix and the description of the outcome/results included in the text of the report.

Grading Breakdown

Assessment Tool (assignments)	% of Grade
Homework	30%
Midterm exam (in class)	45%
Class project	
Project proposal & presentation	5%
Final project & presentation	20%
TOTAL	100%

Assignment Submission Policy

- Project Proposal and Presentation: Week 7
- For **on-campus** students, assigned homework will be collected **in class**. Homework is due one week after it was assigned. **No late homework will be accepted in general.**

Additional Policies

- Midterm exam can be taken on or before the scheduled exam date.
- The exam will be closed book, closed notes. One page (8 ½ x 11) formula sheet can be used. Be sure to bring your calculator. There will be **ABSOLUTELY NO SHARING** among students of books, formula sheets, or calculators.
- Please show steps in your work in order to gain partial or full credits.
- If you believe there was an error in the grading of an exam, then you can submit the entire exam to the instructor requesting to re-grade. This must be done **within one week** from the date the exam was returned. The entire exam will be re-graded, so that you may gain, or lose, points by resubmitting.
- During class time, please **turn off** all cell phones.
- Students are responsible for all information conveyed during class and on Blackboard (www.uscdcn.net). It is the student's responsibility to make sure they are receiving their emails related to the class.
- Always bring your textbook to class! Also bring your calculator, notebook, pencils/pens, eraser, and course syllabus.
- If there is any discrepancy between class policy and DEN or USC policy, we will follow DEN/USC policy.

	Topics/Daily Activities	Readings/Preparation
Week 1	Introduction of course policy, DOE, and causal inference	Chapter 1
Week 2	linear model, simple linear regression and One-way ANOVA	Chapter 1 and 2
Week 3	One-way ANOVA with random effect and examples	Chapter 2
Week 4	A/B Testing and application; Paired comparison & randomized block design	Chapter 2 and 3 HW#1 Due
Week 5	Two-way layout, multi-way layout, Latin square design, balanced incomplete block designs In-class lab sessions	Chapter 3
Week 6	Transformation of response, factorial design at two levels	Chapter 4 HW#2 Due
Week 7	Factorial effects and plots, effect estimation, regression model, half-normal plot, two-step procedure	Chapter 4
Week 8	Effect aliasing, resolution, and minimum aberration; Design of 2^{k-p} fractional factorial design	Chapter 5 HW#3 Due
Week 9	Midterm and 3^k full factorial design	Chapter 6
Week 10	3^{k-p} fractional factorial designs and introduction to response modeling	Chapter 6 and 10 HW#4 Due
Week 11	Central composite designs and robust parameter design	Chapter 10 and 11 HW#5 Due
Week 12	Experimentation strategies and introduction of Computer Experiments Design	Chapter 11 and 12
Week 13	Gaussian process modeling and analysis	
Week 14	Applications of computer experiment design in large-scale simulations	HW#6 Due
Week 15	Final Project Presentation	
FINAL	Refer to the final exam schedule in the USC <i>Schedule of Classes</i> at classes.usc.edu.	Final Project Report

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.