

STAT 514 Design of Experiments

Dr. Lin Wang,
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Lectures Time:

MWF 1:30 – 2:20 pm

Classroom: SCHM 113

Office hours: W 3:30 – 4:30 PM, MATH 242

Course Description and Learning Outcomes:

This course provides an introduction to the principles and techniques of experimental design, with an emphasis on planning, conducting, and analyzing experiments to obtain valid and objective conclusions. Experimentation is a cornerstone of innovation, supporting activities such as new product design, process development, and continuous improvement in manufacturing. Beyond these settings, designed experiments are widely applied in fields such as marketing, service operations, and business decision-making.

Students will learn how designed experiments drive both breakthrough and incremental innovation by enabling data-driven insights. The course covers strategies for developing effective experimental designs across diverse applications and for building statistical models that transform experimental data into reliable predictions and interpretations. By the end of the course, students will be equipped with practical tools for applying experimental design as a key technology for innovation in science, engineering, and business.

Prerequisites:

1. Linear algebra is required. Familiarity with the notation of matrices is assumed. 2. An introductory course in statistics is required. 3. R coding is required for computation and homework assignments. You do not have to be proficient in R at this time, but be prepared to learn and use some fundamental coding techniques in this course.

References:

Montgomery, D. C. (2019). Design and Analysis of Experiments, 10th Edition. John Wiley & Sons.

Course website:

All teaching materials, announcements, homework will be posted on Brightspace website <http://purdue.brightspace.com>.

Grading Rule:

Assignments: 20% (all assignments have equal weight, lowest score will be dropped);

Midterm Exam 1: 15%;

Midterm Exam 2: 15%;

Final Project: 20%;

Final Exam: 30%.

The percentage grades needed to achieve an A, B, C, D, or F will follow approximately the following scale: $90 - 100 = A$, $80 - 89 = B$, $70 - 79 = C$, $60 - 69 = D$, below 60 is F. The instructor reserves the right to change the rule of letter grade assignment and assign “+” or “-” letter grades.

Examinations:

Midterm Exam 1: F 2/13 in class

Midterm Exam 2: F 3/13 in class

Final Exam: To be announced by the Office of Registrar

- Students who registered with DRC can take the exam at the DRC facility. Those students must contact Dr. Wang asap to discuss the exam time and submit a DRC test request at <https://www.purdue.edu/drc/testing/requesting-an-exam.php>, at least one week before the exam date.
- Students who have schedule conflicts may take the exam at a different time upon Dr. Wang’s approval. Acceptable excuses include Grief, Military, Jury Duty Absences, etc. Those students must contact Dr. Wang asap, and provide the necessary proof.
- Students who have medical conditions may take the exam at a different time upon Dr. Wang’s approval. Those students must contact Dr. Wang asap with a proper doctor’s note.

Students, who are eligible for the above exceptions, but fail to contact Dr. Wang properly and don’t attend the in-person exam, will be considered absent from the exam and receive 0 pt for the exam.

Topics

We will cover the following topics.

- An introduction to strategy and principles of experimentation
- Linear regression with numerical and categorical factors (matrix notations)
- Simple comparative design
- Completely randomized design

- Post hoc tests: Fisher's and Tukey's methods
- The blocking technique: randomized complete block design
- Factorial design, 2^k factorial design
- Fractional factorial design with two levels
- Optimal design
- Response surface methodology, steepest ascent method
- Computer experiments and space-filling design

Attendance, Homework, Exam policy:

- Class attendance is an important part of your success in the class. The syllabus, homework assignments, exam dates, etc. may be changed by in-class announcements. Low attendance without proper excuses may cause a penalty to the final grade.
- The homework will be assigned approximately one week before its due date and will also be posted on the class website. The homework must be finished (written) independently. Discussion is okay, but identical copies are not acceptable since your homework must reflect YOUR understanding of the material. If identical solutions are found, all the parties involved will receive a 0 on that assignment. Homework shall be submitted directly on the course website.
- No late assignments will be graded. To allow for illness, family emergencies, etc., the lowest homework score will be dropped at the end of the fall semester.
- A makeup examination will be only given to the students who could provide satisfactory evidence that the absences are due to some causes beyond their control (e.g., Grief, Military, and Jury Duty Absences). Contact me as soon as possible if you are unable to take an exam at the scheduled time. It is STUDENT'S responsibility to contact me IN ADVANCE to check if a make-up is possible. I will not accept the request of make-up exam AFTER the exam time with non-emergency excuses.

ADA, Plagiarism, Academic Integrity and Nondiscrimination Statement:

- STATEMENT ON DISABILITIES: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for

persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation for their disabilities.

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center (DRC) at: drc@purdue.edu or by phone: 765-494-124. If you have registered with DRC and have an Accommodation Letter from DRC, or you are in need of academic accommodations, please contact me as soon as possible.

- **STATEMENT ON PLAGIARISM:** The handouts used in this course are copyrighted. By "handouts," I mean all materials generated for this class, which include but are not limited to syllabi, quizzes, exams, lab problems, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless I expressly grant permission. As commonly defined, plagiarism consists of passing off as one's own ideas, words, writing, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you should have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research cannot be safely communicated.

- **ACADEMIC INTEGRITY STATEMENT:**

Academic integrity is one of the highest values that Purdue University holds. Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, University Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972].

Individuals are encouraged to alert university officials to potential breaches of this value by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate

the concern.

The Purdue Honor Pledge “As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do.Accountable together - we are Purdue”.

Any confirmed academic misconduct activity in this course leads to punitive grading.

- **NONDISCRIMINATION STATEMENT:** Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.
- **VIOLENT BEHAVIOR POLICY:** Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activities.
- **EMERGENCY PREPARATION:** In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor’s control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

Guidelines regarding ensuring access to emergency information:

- Keep your cell phone on to receive a Purdue ALERT text message
- Log into a Purdue computer connected to the network to receive any Desktop Popup Alerts
- If you have a “no cell phone” in class policy allow one or two students who have signed up for Purdue ALERT to keep their phones on to receive any alerts