**ASEN 5137: Experimental Design and Statistical Methods**

**1. Overview**

This 5000-level graduate student course is aimed at examining the applied issues of designing experiments and performing statistical analyses to reach justified scientific conclusions. The approach will rigorously address the mathematical underpinnings of statistical tests and modeling through applied examples. Efficient and appropriate experimental design approaches will be integrated with statistical analysis techniques to enable application to real-world research questions. A special focus will be placed on the unique challenges of experiments with human participants and their inherent variability. Statistical software (e.g., R) will be used extensively.

A wide range of topics will be covered to provide a “one stop” overview of experimental statistics for the engineer. This includes data visualization, hypothesis formulation, inferential statistics (e.g. t-test), briefly correlation and (multiple) regression, uncertainty and confidence intervals, ANOVA (fixed effects, random effects, and mixed), ANOVA-derived methods (e.g. ANCOVA, Nested designs), post-hoc comparisons and corrections, diagnostics and remedial measures, predictive and descriptive modeling, and best practices for reporting statistics in publications. Approaches and challenges that are common for experiments with human participants will receive special attention, including repeated measures (within participants) designs and analyses, outlier identification, non-parametric techniques, and small N approaches such as Bayesian statistics. Additional topics beyond the scope of the course will be touched upon to provide guidance for self-exploration of areas of interest for individuals’ research.

A detailed schedule of topics is available in the form of an Excel spreadsheet in the course files.

**2. Assessment**

Table 1 outlines the material by which student performance will be assessed. The primary evaluative components of the course will be homework and exams. There will also be a semester group project, with teams of up to 4 people performing an experiment with statistical analyses. This course will have 2 exams, but we will not use the time slot assigned during finals week. Additional details on timeline and due dates can be found in the course schedule document.

| Table 1: Distribution of course assessments | Percentage |
| --- | --- |
| Exams (2) | 40% |
| Homework (4) | 40% |
| Semester Project | 20% |
|  | **100%** |

 Letter grading scheme

|  |  |  |
| --- | --- | --- |
| Letter | Grade percent | 4.00 scale |
| A | 93.00—100.00  | 4.00 |
| A- | 90.00—92.99 | 3.67 |
| B+ | 87.00—89.99 | 3.33 |
| B | 83.00—86.99 | 3.00 |
| B- | 80.00—82.99 | 2.67 |
| C+ | 77.00—79.99 | 2.33 |
| C | 73.00—76.99 | 2.00 |
| C- | 70.00—72.99 | 1.67 |
| D+ | 67.00—69.00 | 1.33 |
| D | 63.00—66.99 | 1.00 |
| F | Below 63.00 | 0.00 |

*Exam times and locations:*

Exam 1: 3-hour exam during the 24-hour period starting 12:50pm Oct. 3 and ending 12:50pm Oct. 4 (no class on exam day)

Exam 2: 3-hour exam during the 24-hour period starting 12:50pm Nov. 21 and ending 12:50pm Nov. 22 (no class on exam day)

Final presentations: December 1st, 3rd, and 5th, 12:50-1:40pm, AERO N240

No makeup homework or exams will be offered. Students with known exam schedule conflicts should reach out ASAP to come up with an alternative time to take the exam. Distance students are expected to take exams during the same time window as in-person students. Extensions for homework assignments may be granted under some circumstances, but extensions will in general not be granted within 24 hours of the assignment due date. Communicate issues early!

**3.** **Textbook**

There is no required textbook for the class. An online version of the primary text, “Applied Linear Statistical Models” by Kutner, Natchtsheim, Neter, and Li, can be found here:

<http://users.stat.ufl.edu/~winner/sta4211/ALSM_5Ed_Kutner.pdf>

Readings will be assigned from other resources as needed and will be announced at least one week in advance of the due date.

## 4. Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the[Honor Code](https://www.colorado.edu/sccr/media/229). Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part of adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating theHonor Code will be assigned resolution outcomes from Student Conduct & Conflict Resolution and will be subject to academic sanctions from the faculty member. Visit [Honor Code](https://www.colorado.edu/sccr/media/229) for more information on the academic integrity policy.

## 5. Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed.  Disability Services determines accommodations based on documented disabilities in the academic environment.  Information on requesting accommodations is located on the [Disability Services website](https://www.colorado.edu/disabilityservices/). Contact Disability Services at 303-492-8671 or DSinfo@colorado.edu  for further assistance.  If you have a temporary medical condition, see [Temporary Medical Conditions](https://www.colorado.edu/disabilityservices/students/temporary-medical-conditions) on the Disability Services website.

If you have a temporary illness, injury or required medical isolation for which you require adjustment, please reach out to your faculty member as soon as possible.

## 6. Accommodation for Religious Obligations

Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments, or required attendance. Please communicate the need for a religious accommodation in a timely manner. In this class, please advise the faculty member of any schedule conflicts by the end of the first week of classes so accommodations can be made. See the [campus policy regarding religious observances](https://www.colorado.edu/compliance/policies/observance-religious-holidays-absences-classes-or-exams) for full details.

## 7. Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information does not always align with how they identify. If you wish to have your preferred name (rather than your legal name) and/or your preferred pronouns appear on your instructors’ class rosters and in Canvas, visit the [Registrar’s website](https://www.colorado.edu/registrar/students/records/info/preferred) for instructions on how to change your personal information in university systems.

## 8. Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.

### **Additional classroom behavior information**

* [Student Classroom and Course-Related Behavior Policy](https://www.colorado.edu/compliance/policies/student-classroom-course-related-behavior).
* [Student Code of Conduct](https://www.colorado.edu/sccr/media/230).
* [Office of Institutional Equity and Compliance](https://www.colorado.edu/oiec/).
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## 9. Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits [protected-class](https://www.colorado.edu/oiec/policies/protected-class-nondiscrimination-policy/protected-class-definitions) discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email OIEC@colorado.edu. Information about university policies, [reporting options](https://www.colorado.edu/oiec/reporting-resolutions/making-report), and [OIEC support resources](https://www.colorado.edu/oiec/support-resources) including confidential services can be found on the [OIEC website](https://www.colorado.edu/oiec/).

Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something occurred. This is to ensure the person impacted receives outreach from OIEC about resolution options and support resources. To learn more about reporting and support a variety of concerns, visit the [Don’t Ignore It page](https://www.colorado.edu/dontignoreit/).

## 10. Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact [Counseling and Psychiatric Services (CAPS)](https://www.colorado.edu/counseling/), located in C4C, or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through [AcademicLiveCare](https://www.colorado.edu/health/academiclivecare). The [AcademicLiveCare](https://www.colorado.edu/health/academiclivecare%22%20%5Ct%20%22_blank%22%20%5Co%20%22https%3A//www.colorado.edu/health/academiclivecare) site also provides information about additional wellness services on campus that are available to students.

## 11. Acceptable Use of AI in This Class

Generative artificial intelligence tools—software that reproduces text, images, computer code, audio, video, and other content—have become widely available. Well-known examples include ChatGPT for text and DALL•E for images. This statement governs all such tools, including those released during our semester together. Keep in mind that the goal of gen AI tools is to reproduce content that seems to have been produced by a human, not to produce accurate or reliable content; therefore, relying on a gen AI tool may result in your submission of inaccurate content. It is your responsibility—not the tool’s—to assure the quality, integrity, and accuracy of work you submit in any college course. If gen AI tool use is suspected in completing assignments for this course in ways not explicitly authorized, I will follow up with you. I may contact the Office of Student Conduct & Conflict Resolution to report suspected Honor Code violations. In addition, you must be wary of unintentional plagiarism or data fabrication. Please act with integrity, for the sake of both your personal character and your academic record.

Limited Gen AI Use: You may use gen AI tools for specific functions in this course that will augment your learning, but their use is limited to the following particular tasks: generating example data sets to practice a statistical approach, using Co-pilot or other coding support tools (it is your responsibility to check that your code functions as intended). You are not permitted to use Gen AI for problem-solving on your homework or exams, and you are not permitted to use Gen AI to generate text for any written assignment.