Carleton University
Department of Civil and Environmental Engineering
Fall 2022 | ECOR 2050: Design and Analysis of Engineering Experiments

Instructors:
Sections A & B:
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Section C:
Dr. Cole Van De Ven, cole.vanadeven@carleton.ca  Office: Engineering Design Centre (EDC) 4531

Office Hours
The instructors STRONGLY encourage anyone attending office hours to please wear a mask.

TBD - Hours to be set after the first week of lectures

Schedule

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Day</th>
<th>Time</th>
<th>Building/Room</th>
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</thead>
<tbody>
<tr>
<td>Section A</td>
<td>Wednesday/Friday</td>
<td>1:05 pm – 2:25 pm</td>
<td>UC 231</td>
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<tr>
<td>Section B</td>
<td>Tuesday/Thursday</td>
<td>8:35 am – 9:55 am</td>
<td>UC 231</td>
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<tr>
<td>Section C</td>
<td>Tuesday/Thursday</td>
<td>4:05 pm - 5:25 pm</td>
<td>AT 102</td>
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Course Description
Engineering designs and decisions are often made under uncertainty because engineers do not have the resources (time, money,..) to conduct every experiment and obtain all of the data of interest of the project to support their decisions/designs. Statistics and probability concepts are used to quantify this uncertainty by designing experiments and properly collecting, analyzing and interpreting data in a way that can reduce the risk and improve the reliability in our design and decision making.

Intended Learning Outcomes
Upon the completion of this course, you should be able to:

- Describe and calculate common statistical parameters and construct experimental plots
- Explain basic probability concepts and follow continuous probability distributions
- Identify between samples and populations and follow sampling distributions
- Apply statistical and probabilistic analysis to estimate population parameters or test hypotheses about them based on experimental data/samples
- Implement randomized experimental design to collect unbiased and independent samples for data analysis
- Formulate simple linear regression analysis to build empirical models
- Interpret resulting data to obtain objective conclusions and communicate the results effectively
Graduate Attributes (GAs)
GAs are assessed in preparation for accreditation by Engineers Canada. It is to ensure that authorities recognize our graduates as meeting the academic requirements for licensure.

The following GAs will be assessed in this course:

1.1 - Mathematical skills
3.1 - Complex problem assessment
3.2 - Design of experiments
3.3 - Experimental procedure
3.4 - Data reduction methods and results
3.5 - Interpretation of data (synthesis) and discussion

Topic Summary

<table>
<thead>
<tr>
<th>Week* (approximate)</th>
<th>Anticipated Topic*</th>
<th>Assessment*</th>
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<tbody>
<tr>
<td>1</td>
<td>Chapter 1: Exploratory Data Analysis: statistics in engineering, descriptive statistics, graphing experimental data, introduction to population and sampling</td>
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<td>2</td>
<td>Chapter 2: Probability Concept and Distribution: basic probability concepts, random variables, probability density function and probability mass function, normal distribution</td>
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<td>3</td>
<td>Chapter 3: Sampling: sampling design, central limit theorem, sampling distribution of mean (z and t distributions), sampling distribution of variance (chi-square distribution), F distribution, point and interval estimation, confidence interval, sample size</td>
<td>1 (Chapter 1)</td>
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<tr>
<td>4</td>
<td>Chapter 4: Hypothesis Testing: terminology and definitions (null and alternative hypothesis, Type I and Type II error, p-value), degrees of freedom, t-test, chi-square test, F test</td>
<td>2 (Chapter 2)</td>
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<tr>
<td>5</td>
<td>Chapter 5: Basics of Design of Experiments: terminology, randomization, experiments with a single factor, two-factor experiments, ANOVA, introduction to factorial design</td>
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<tr>
<td>6</td>
<td>Chapter 6: Regression Analysis: simple linear regression, diagnostic tests concerning linear regression (correlation, ANOVA, residuals, slope), prediction confidence</td>
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<tr>
<td>7</td>
<td>Chapter 7: Regression Analysis: simple linear regression</td>
<td>3 (Chapter 3)</td>
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<tr>
<td>8</td>
<td>Chapter 8: Regression Analysis: simple linear regression</td>
<td>Midterm**</td>
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<tr>
<td>9</td>
<td>Chapter 9: Regression Analysis: simple linear regression</td>
<td>4 (Chapter 4)</td>
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<tr>
<td>10</td>
<td>Chapter 10: Regression Analysis: simple linear regression</td>
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<tr>
<td>11</td>
<td>Chapter 11: Regression Analysis: simple linear regression</td>
<td>5 (Chapter 5&amp;6)</td>
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<tr>
<td>12</td>
<td>Chapter 12: Regression Analysis: simple linear regression</td>
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* Subject to change
** Midterm will be between November 1 to November 11. Exact date will be decided based on the most popular date determined by survey results

Lecture Notes
Lecture notes will be posted periodically on Brightspace. The notes are designed to supplement lectures, but do not represent the complete content of the course (for that you should attend the lectures). Some sections of the notes are left blank. We will fill them throughout lectures but filled notes will not be provided. Please be prepared to fill in your notes by hand, tablet, computer, or any approach you find works best for you.
Lectures will NOT be recorded by the instructor and students do NOT have permission to record lectures.
References

Labs/Tutorials
Lab sessions (tutorials) will be run by teaching assistants (TAs), starting Week 2 or 3 (to be announced). During these sessions, TAs will solve example problems that help you prepare for assignments and exams. At the end of each session, the TA will hold a 1-hour office hour to answer your questions. Attending labs is not mandatory but highly recommended.

Marking Scheme
Your overall course grade will be determined using the following scheme:

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<thead>
<tr>
<th></th>
<th>Midterm</th>
<th>Assignments (5)</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30%</td>
<td>20%</td>
<td>50%</td>
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Homework Assignments
To aid your mastery of the course concepts, problems will be assigned as 5 assignments. Doing the homework will help prepare you for exams. Marks are awarded for a complete and proper writing of the solution (including units, assumptions, conclusion statements, etc.), not just the right answer. Using methods/equations that are not covered in class and not included in formula sheet is not acceptable and such solutions will not receive a grade. Assignments should be submitted on Brightspace in 1 file in pdf format.

Late Submission Policy
Assignments should be submitted by the due date. If you cannot meet a deadline, please make arrangements with the instructor before the deadline; otherwise a penalty of 10% per day will be deducted from your grade up to 2 days or until the solution set is posted. Late submissions are not accepted after solution set is posted and will result in a grade of zero, unless appropriate documentation is provided. If you miss an assignment due to extenuating circumstances, you are responsible for informing your instructor within 3 days of the deadline. Documentation verifying the severity of the situation will be required to provide accommodations.

Midterm
Midterm will be held during a lecture time, between November 1 to November 11. Exact date will be decided based on the most popular date determined by survey results. It will be a closed book test on Chapter 1 to 3, that serves as formative assessments of your learning. Midterm will be proctored. To be eligible to pass the course, you must receive a minimum 35% of the midterm. Marks are awarded for a complete and proper writing of the solution (including units, assumptions, conclusion statements, etc.), not just the right answer. Using methods/equations that are not covered in class and not included in formula sheet is not acceptable and such solutions will not receive a grade.
If you miss an exam due to extenuating circumstances, you are responsible for informing your instructor within 3 days of the test. Documentation verifying the severity of the situation will be required to provide accommodations.

Appeals
You should bring any grading appeals to your instructor’s attention within 7 days of grades being posted. A brief description of your concern should be submitted in an email to your instructor. Teaching Assistants will not change any marks.

Final Exam
This course has a two-hour final exam (to be scheduled in final exam period) which will be an individual closed book test on all the chapters. Final Exam will be proctored. Marks are awarded for a complete and proper writing of the solution (including units, assumptions, conclusion statements, etc.), not just the right answer. Using methods/equations that are not covered in class and not included in formula sheet is not acceptable and such solutions will not receive a grade. Those who have received below 35% (or missed) in the midterm, are not eligible to write the final exam, unless special accommodations are considered by the instructor.

Final Grades
Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean. Grades are considered FINAL and will NOT be changed after approval by the Dean.

Course Material Copyright
Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by instructor, guest lecturers, teaching assistants, and students, are copyright protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are protected by copyright and remain the intellectual property of their respective author(s).

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to record lectures on their own. Students are NOT permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

Academic Integrity
Students are expected to know what constitutes Academic Integrity, to avoid committing academic offences, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offence, or who need help in learning how to avoid offences (e.g., plagiarism, cheating, etc.) or about "rules" for group work/collaboration should seek guidance from the course instructor, advisor, or the Undergraduate Associate Dean. The “Academic Integrity Policy” can be found at: carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf.
Inclusivity in the classroom
We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space (virtual) which we work in will be safe for everyone. Please be considerate of everyone’s personal beliefs, choices, and opinions.

Students Responsibilities
Specific student responsibilities for ECOR 2050 are:

- You must abide by Academic Integrity terms, including but not limited to:
  - You must complete and submit exams as an individual using only the allowable aids.
  - You must complete and submit assignments as an individual according to the given instructions.
- You must understand and abide by Copyright terms. Course content including are intellectual property of the instructor. Sharing and posting any part of the course content (lecture notes, assignments, tutorials, and exam questions) on internet or any media outlet/platform is a copyright infringement that can result in serious consequences.
- Your behavior must be respectful and professional during the lectures, tutorials, and office hours and also in email communication.
- You are responsible for knowing the course schedule and must monitor Brightspace and e-mails (sent by the instructor/TAs) for changes to the schedule and general announcements.
- You are responsible for informing your instructor when you miss a test or assignment due to extenuating circumstances (within 3 days). Documentation verifying the severity of the situation will be required to provide accommodations.

Course Completion
Please take careful note of Section 5.1 of the Academic Regulations in the Undergraduate Calendar (https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/grading/#credit):
“To obtain credit in a course, students must satisfy the course requirements as published in the course outline.”
- You will fail the entire course if you do not obtain at least 35% on the midterm.
- Copyright and/or Academic Integrity offences will result in failing the course (instructor’s decision) and can result in suspension or expulsion from the University (Associate Dean’s decision).

Student Accommodations
Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals. Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.
You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:
Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the Paul Menton Centre website.

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the Senate Policy on Accommodation for Student Activities (PDF, 25KB).

Pregnancy Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB).

Religious Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit the Equity and Inclusive Communities website.

Addressing Human Rights Concerns: The University and all members of the University community share responsibility for ensuring that the University’s educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca.
Mental Wellness
If you find yourself suffering during this or any other term from anxiety, stress, or issues related to mental health, this is nothing to be ashamed of. It is highly recommended that you seek help; refer to Counselling Services. You are also welcome to reach out to the instructor to discuss on-campus resources.

Special Information for Pandemic Measures
It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you’re sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton’s symptom reporting protocols. Please note that reasonable accommodations will be made for those who are ill. It is best to stay home if not well.

Masks: Carleton has paused the COVID-19 Mask Policy, but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton’s COVID-19 response and health and safety requirements please see the University’s COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.