

# Carleton University

## Department of Civil and Environmental Engineering

### Fall 2020 | ECOR 2050: Design and Analysis of Engineering Experiments

#### Instructor:

Shoeleh Shams, [shoeleh.shams@carleton.ca](mailto:shoeleh.shams@carleton.ca)

#### Office Hours

Wednesday and Friday, 11:00 am– 12:00 pm, starting Friday September 18th

#### Schedule

Lecture	Day	Time
<b>Section A</b>	Tuesday/Thursday	4:05 – 5:25 pm
<b>Section B</b>	Wednesday/Friday	1:05 – 2:25 pm

#### Course Objective

Engineering designs and decisions are often made under uncertainty; i.e. engineers do not have the time and/or money to conduct every experiment and obtain all of the data of interest regarding the project. Statistics and probability concepts are used to quantify this uncertainty and design experiments in a way that can hopefully reduce the “risk” and improve the “reliability” in our design and decision making.

The purpose of this course is to:

- Learn the basic concepts of statistics and probability;
- Apply the concepts in planning, designing, and conducting experiments (to improve reliability and reduce costs); and
- Analyze and interpret the resulting data to obtain objective conclusions and communicate the results effectively.

#### Graduate Attributes (GAs)

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; and
- 3.5 - Interpretation of data (synthesis) and discussion.

## Topic Summary

Week* (approximate)	Anticipated Topic*
1-2	Exploratory Data Analysis: statistics in engineering, descriptive statistics, graphing experimental data, introduction to population and sampling
3-4	Probability Concept and Distribution: basic probability concepts, random variables, probability density function and probability mass function, normal distribution
5-7	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
8-9	Hypothesis Testing: terminology and definitions (null and alternative hypothesis, Type I and Type II error, p-value), t-test and t-table, degrees of freedom, t-tests, chi-square test, F test
10-11	Basics of Design of Experiments: terminology, experiments with a single factor, randomization, ANOVA, hypothesis tests, introduction to factorial design, two-factor experiments
12	Regression Analysis: simple linear regression, tests concerning linear regression (correlation, ANOVA, residuals)

\* Subject to change

## Lecture Notes and Recordings

Lecture notes will be posted **periodically** on cuLEARN. Recordings of the lectures will be made available to students who are **currently living in a different time zone** or **do not have access to high-speed and reliable internet**. Recordings will be made available for **48 hours** after the end of lecture. If you need access to recordings, you should inform the instructor before **September 4th**. If a student misses a lecture due to **technical/connection issues**, they can request access to recordings for that specific lecture. Students who request/get access to recordings must sign an **Affidavit** (confidentiality agreement), stating that they will not share the recordings nor post them on any media outlet.

## References

1. Montgomery D.C. and Runger G.C., Applied Statistics and Probability for Engineers. 7th Edition. 2018, John Wiley & Sons, Inc.
2. Montgomery D.C., Runger G.C., and Hubele, N.F. Engineering Statistics. 5th Edition, 2010, John Wiley & Sons, Inc.
3. Walpole R.E., Myers, R.H., Myers, S.L., Ye, K.E. Probability and Statistics for Engineers and Scientists. 9<sup>th</sup> Edition. 2010, Pearson.
4. Montgomery. D.C., Design and Analysis of Experiments. 8th Edition. John Wiley & Sons, Inc.

## Marking Scheme

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

Midterm	Assignments (4)	Final
30%	20%	50%

## Homework Assignments

To aid your mastery of the course concepts, problems will be assigned as 4 assignments. You will see solutions to problems similar to the assignments as **tutorials/labs**. 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. **ALL problem sets must be submitted to be eligible to pass this course.** Failing to submit one (or more) assignment(s) will result in disqualification from writing the final exam and passing the course. Assignments should be submitted on cuLearn in **1 file** in acceptable formats (pdf and word document).

## 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 3 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 the term (approximately Week 7). It will be a closed book test that serves as formative assessments of your learning. **To be eligible to pass the course, you must receive a minimum 40% 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.**

**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.

## 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. Marks are awarded for a complete and proper writing of the solution (including units, assumptions, conclusion statements, etc.), **not just the right answer.**

**Those who have not submitted all the assignments or have received below 40% (or missed) in the midterm, are not eligible to write the final exam.**

## 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.**

## Student Responsibilities

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](http://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf).

### Specific student responsibilities for ECOR 2050 are:

- Course content including recordings, lecture notes, and all examples (assignments, tutorials, and exam questions) are intellectual property of the instructor. **Sharing and posting any of that on internet/any media outlet is a copy-right offence that can result in serious consequences.**
- Your behavior must be respectful and professional in the virtual environment of lectures and tutorials and also in email communication.
- You must complete and submit exams as an individual using only the allowable aids.
- You must complete and submit assignments according to the given instructions.
- **You are responsible for knowing** the course schedule and must monitor cuLEARN 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.

## Student Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

**Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your **Letter of Accommodation** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). **Requests made within two weeks will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website ([www.carleton.ca/pmc](http://www.carleton.ca/pmc)) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

**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 policy](#).

**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, visit [the Equity Services website](#).

**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, visit [the Equity Services website](#).

**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 [carleton.ca/sexual-violence-support](http://carleton.ca/sexual-violence-support).

### **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](#).