***CEE 202 Engineering Risk and Uncertainty***

***Fall 2024***

***Class times: Tu/Th 11:00 – 12:20 Location: NCEL 1310***



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## What is this course about?

Introductory course for civil and environmental engineering students to learn the basic probabilistic concepts and statistical analysis methods, which constitute key background that helps CEEs obtain information from data, assess risk, evaluate uncertainty, test scientific hypotheses and build certain types of mathematical models.

**Class website:** <https://canvas.illinois.edu/courses/46906>

**Learning Objectives**

After completing this course, you will be able to

1. Use probability, probability models and statistics in the engineering problem-solving process.
2. Describe how natural or experimental variability affects the data collected and used for making engineering decisions.
3. Use probability distribution functions for describing data resulting from an experiment.
4. Calculate probabilities given probability distribution functions.
5. Calculate statistical summaries of data.
6. Make graphs and interpret information in graphs.
7. Derive general conclusions based on collected data, using scientifically developed, tested and accepted methods.
8. Build and evaluate a simple linear model using collected data.
9. Articulate your work, interpretations and conclusions in writing.
10. Assess and improve your teamwork and interpersonal communication skills.

## Who is teaching this course?

|  |  |
| --- | --- |
| Dr. Sotiria Koloutsou-Vakakis sotiriak@illinois.edu  | **Teaching Assistants**Qurat Ul Ain Fatima, Qurat qfatima2@illinois.edu Zhang, Sean sz54@illinois.edu Chang, Yi-Chia yichia3@illinois.edu **Class Assistant**Vazquez, Jovany jvazq7@illinois.edu  |

## How can I contact my teacher and TAs?

3 ways for you to communicate with us: 1) e-mail recommended for matters of a personal nature, specific to you only; 2) Course [campuswire](https://campuswire.com/) channel (typically everyone in class can see the communication); 3) in person, during office hours and help sessions.

We use two ways to send out information to you: 1) Canvas announcements (frequent and predictable- typically weekly reminders-keep an eye for them); 2) e-mail to your U of I address (only when your immediate attention is needed).

**PLEASE use ONLY** **yournetID@illinois.edu** **account for all communications related to this class and for logging in to Canvas, PrairieLearn, campuswire and Zoom.**

## How is this course taught?

**Active learning**

As part of a Grainger College of Engineering initiative, this class is being updated to the student-centered model. What is student-centered learning? In the student-centered learning paradigm, the teacher is the facilitator, while the student is the one who makes the discovery, with the support of the teacher, always. In a sense, using the analogy to sports, the teacher acts as a coach, giving the materials, the prompts and the guidance, while boosting the student’s confidence to learn. The main idea here is that the human brain really learns, when the individual is really involved.

We adopt this model because it makes total sense to us for your development of technical and professional skills. It is honest to acknowledge, that shifting to this model is not easy for your teachers because we are conditioned to teach the way we were taught (…even if we hated it). What we would like you to remember is that we are committed to supporting your learning journey and we are working hard on that. During the semester we will ask for your feedback a couple of times so that we can monitor how things work.

**Class Organization:**

***Pre-lectures:***

Pre-lecture quiz-videos and the Narration notes files accompanying them, provide an introduction to the material you work with, in class, in the next class period. You are expected to watch the video, answer the quiz question and note down your own questions. Watching the pre-lecture video is your study time, in an inversed way. Make sure you spend the 10-20 overall min productively. Suggested to write down questions as you watch the video, which you then bring to class for discussion with team and teachers.

***Worksheets:***

When you come to class, you join your team and you start working on the worksheet, after the Professor gives a review of the key concepts introduced in the pre-lecture videos. Worksheets follow up on the pre-lecture video material, to further support your learning through discovery.

Think of it as an inverse way of what you might have been doing till today. Your studying starts with the pre-lecture, worksheets help your understanding and teachers are there to help you find the answer on your own. And we all know how good that feels!

***Teams:***

You are randomly assigned to teams of 3 - 4. Besides classwork, you will be assigned a team project, to be worked in stages throughout the semester. Team members always sit together in class and work together on worksheets. Before the project is assigned, your assignment into teams which cooperate during class time aims to help team members get to know each other and establish a communication and rules of cooperation that will help you All work productively on your project.

***Recommended team task rotation:***

For class: rotate every class who is leading teamwork on the day.

For team project: Rotate roles for each part of the team project.

For example:

Student 1: Communications officer (but do not forget to cc all teammates in communications with teaching team).

Student 2: Scheduler (creates communication channel, schedules meetings – reserves space or creates virtual meetings).

Student 3: Manager (coordinates team to develop timeline, division of labor, contributes their part while overseeing timely submissions by others.)

Student 4: Integrator of individual contributions into a single report.

Student 5: Quality checker (correctness, format, clarity, organization). In 4 member teams, role can be assumed by communications officer).

Each team member works on their role while contributing their fair share to the analysis and writing.

**Every team member must participate in the data analysis, interpretation and development of the R script**. Otherwise not everyone gets the learning benefit and apparently learning missed this semester will bring you trouble in subsequent semesters, as this is a background building course.

Teams are meant to:

* 1. motivate your active involvement in the class.
	2. promote teamwork (students work together and support each other while developing interpersonal skills).
	3. create a sense of community (a big class is more than a group of strangers sharing a classroom - it is a learning community and support network of peers and colleagues).
	4. teach you (through practicing and self-learning and improvement) task delegation, time management, and meeting deadlines while managing a team.
	5. help you learn to work with focus on a shared goal, pushing aside any differences.
	6. teach you the importance of mutual respect for each other and to team-agreed-upon procedures.

For these reasons, teamwork MUST happen as teamwork, where every member of the team is involved in **all** parts and aspects of the project. If your team is found to not follow this rule, then your team’s grade will suffer penalties. Teamwork is graded because it is very important to engineers!

## What equipment do I need for this course?

Consistent with campus recommendations and class needs, the following are needed:

* a laptop.

***Textbook (recommended):***

* Montgomery & Runger, Applied Statistics and Probability for Engineers, any edition 5th and later. (We do not require the textbook, but it is a great resource that covers in more detail the material we cover in class and offers many solved examples.)

### General ‘netiquette’

In any social interaction, certain rules of etiquette are expected and contribute to more enjoyable and productive communication. The following are tips for interacting online via e-mail or discussion board messages, adapted from guidelines originally compiled by Chuq Von Rospach and Gene Spafford (1995):

Remember that the person receiving your message is someone like you, deserving and appreciating courtesy and respect.

* Avoid typing whole sentences or phrases in Caps Lock.
* Be brief. Succinct, thoughtful messages have the greatest effect.
* Your messages reflect on you personally; take time to make sure that you are proud of their form and content.
* Make sure grammar and syntax are correct. Avoid using abbreviations many people might not be aware of what they mean, even if they are widely used by your age group or circle of friends.
* Use descriptive subject headings in your e-mails.
* Think about your audience and the relevance of your messages.
* Be careful when you use humor and sarcasm; absent the voice inflections and body language that aid face-to-face communication, internet messages are easy to misinterpret.
* When making follow-up comments, summarize the parts of the message to which you are responding.
* Avoid repeating what has already been said; needless repetition is ineffective communication.
* Cite appropriate references whenever using someone else's ideas, thoughts, or words.

## Where can I find…?

***Class Webpage:***  [https://canvas.illinois.edu/courses/46906](https://canvas.illinois.edu/courses/46906/assignments)

We use Canvas for

* Announcements
* Discussion Boards
* Posting worksheets, review materials and filled worksheet .pdfs after class.
* Submission of project parts.

Project parts are always due **before** class, on certain Thursdays. Submit on Canvas.

***PrairieLearn (PL)*** [https://us.prairielearn.com/pl](https://us.prairielearn.com/pl/course_instance/134563/)

We use PL for

* Pre-lecture videos and quizzes
* Homework assignments and practice problems and
* Class worksheet answer submission
* Exams (on CBTF)

Pre-lecture quizzes always due **before** class Tuesdays and Thursdays on PL.

Homeworks always due **before** class, every Tuesday on PL.

In-class worksheet answers due always at the end of class Tuesdays and Thursdays on PL.

## Where will my exams be?

* This course uses the Grainger College of Engineering’s Computer-Based Testing Facility for its exams.
* The policies of the CBTF are the policies of this course, and academic integrity infractions related to the CBTF are infractions in this course.
* If you have accommodations identified by the Division of Rehabilitation-Education Services (DRES) (<http://www.disability.illinois.edu/>) for exams, please submit your Letter of Accommodations (LOA) through the CBTF website (<https://cbtf.illinois.edu/students/dres>) as soon as possible. It can take up to five days for your LOA to be processed and if you make a reservation before your LOA has been processed, your reservation will not include your testing accommodations and you will be required to reschedule. This must be done each semester you use the CBTF.
* If you have any issue during an exam, inform the proctor immediately. Work with the proctor to resolve the issue at the time before logging off. If you do not inform a proctor of a problem during the test, then you forfeit all rights to addressing the problem you experienced during your exam.
* Take the CBTF Orientation (<https://go.illinois.edu/student-orientation>) (10 minutes) and review all instructions on the CBTF website (<https://cbtf.illinois.edu/students>) before your first exam.

## How am I graded?

Pre-lecture quiz 5%

Participation grade: Class worksheet/participation form 5%

Weekly Homework 15%

Team Project (final submission counts 80% of project grade) 25%

Exams (4), worst **of the first 3 exams** dropped if < 3 unexcused absences [[1]](#footnote-1) 50%

**Clarifying note**: the 4th exam is not optional, and it cannot be dropped. The reason for this policy is to highlight the fact that the course continues until the end of the semester and the late material of the course is too important to neglect.

**Please keep in mind that we only check and grade your very last submission on Canvas or Prairie Learn. We ignore any previous submissions. So, if you wish to correct a submission you need to resubmit all the files of a complete submission.**

Final grade cutpoints:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Grade | A+ | A | A- | B+ | B | B- | C+ | C | C- | D+ | D | D- | F |
| Cutpoint | ≥97 | ≥93 | ≥89 | ≥85 | ≥81 | ≥77 | ≥73 | ≥69 | ≥65 | ≥61 | ≥57 | ≥50 | <50 |

### Team grade policies

**Project:** one team grade

**In-class worksheets:** individual grades are averaged for the team. If average > 75%, team get 100%. If team average < 75% team get their actual average score. Absent team members receive no credit, and their grade is not used for the calculation of the team average. The point of this algorithm is to encourage teams to do the best they can and for team members to cooperate in problem-solving and supporting each other.

### Summary of graded materials (other than exams) and their due days

|  |  |  |
| --- | --- | --- |
| **Type of assignment**  | **What is submitted?** | **What day of the week is it due?** |
| **Before class:** watch pre-lecture videos, submit answers to checkpoint questions | Submit answer on PrairieLearn  | Tues and Thur **before** class |
| **In class:** Class worksheet (teamwork) | Submit answer on PrairieLearn (this is your attendance and participation form) | Tues and Thur by end of each class |
| **Homework:**  | Submit on PrairieLearn | Tues **before** class |
| **Team project parts:** | Submission of reports on Canvas  | Certain Thursdays **before** class |

**Class attendance**

It is expected in every lecture. It is a fact that students who come to class achieve higher grades than students who do not regularly attend class. Monitoring attendance is added complexity for the instructors. However, based on our data, it is a mechanism benefiting you and thus, we deem it fully worth the extra time it takes.

**What if you are sick and you must not come to class.**

Illness is an excused absence and does not count against you, provided you send the instructor a doctor’s note. The note does not have to disclose the illness but only state that the doctor recommends you rest for a number of days. While away, make sure to stay in touch with your team, and of course with your instructor and the TAs, so that we can help you to not fall behind.

## Integrity

**CEE Honor Code**

*I pledge to uphold the highest levels of professional and personal integrity in all of my actions, including* 1) never assisting or receiving unfair assistance during exams, 2) never assisting or receiving assistance on class assignments beyond that specified by an instructor, and3) always fullycontributing to group activities that are part of a course activity.

*Behavior not consistent with CEE honor code will result, at minimum, to loss of worst exam drop benefit.*

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/> .

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <http://studentcode.illinois.edu/>.  Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

### Recording and sharing material by students

Recording or posting to any online platforms of material from this course, including lectures, discussions or other materials is forbidden. Any violation of these policies will be forwarded to the Office of Student Conflict Resolution for disciplinary action.

### Use of AI tools

* You may use them as long as you do not lean on them to pass the class. If you lean on them, you null their usefulness for your learning journey.
* If you use AI tools to just get a better grade fast, that’s a bet. They often hallucinate (give a wrong answer). Thus, they can contribute to a worse grade, instead, for which the responsibility is only yours.
* If you use AI, use it AI critically, check the answers based on what you know and what you learn in class.
* Use AI **ethically**!
* **If you use AI cite it!**

Share what you learn. Success and failure stories help us understand these tools better.

## University-wide important policies and resources

**Accommodations for disabilities:**

 We work closely with Division of Rehabilitation-Education Services (DRES) (1207 S. Oak St., Champaign; 333-4603; disability@uiuc.edu) to make sure we offer an optimal learning environment for all our students. Please contact me, as soon as possible, if our arrangements are not adequate for your needs, so that I can work with you to find solutions for any issues.

**Campus safety tips:**

Important to be aware of your surroundings and alert. Visit the campus website for useful information: <https://police.illinois.edu/services/campus-safety-tips/>

**Wellness – Counseling:**

Just because we all have days that are more difficult than others, remember there is help and support. If you experience a problem, it is always best to discuss it. The earlier the better.

**Counseling**: 217-333-3704

<https://counselingcenter.illinois.edu/outreach-consultation-prevention/outreach-consultation-teams>

For mental health emergencies, you can call 911 or walk in to the Counseling Center, no appointment needed.

**Wellness**: <https://campusrec.illinois.edu/programs/student-wellness/dimensions-of-wellness>

**Your Safety:**

Emergencies can happen everywhere. We better be prepared and alert. Please, keep yourselves safe and help keep our campus community safe. Make sure you sign up to ILLINI-ALERT for emergency notifications <http://emergency.illinois.edu>, and read carefully resources on safety at [http://police.illinois.edu/safe](https://urldefense.proofpoint.com/v2/url?u=http-3A__police.illinois.edu_safe&d=DwMCaQ&c=Y6HT0gyZH_Z4ZSRJdNYJeQ&r=ZLZXoV88wAUIP5LuoelFkSm_yGt5QXkLYt6Pbhv1-bA&m=myqo9I4HaDDG48SWb3UUVw8TEuvRMUFpayv6xAX-6I0&s=qA7nkdKYStAQF9cFYL6srDcHMGpP3jKsi0a45G6L2eU&e=).

**Family Educational Rights and Privacy Act (FERPA)**:

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

**Sexual Misconduct Policy and Reporting**:

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University’s Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here:  <https://wecare.illinois.edu/resources/students/#confidential>

**Religious Observances**

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. **You should examine this syllabus at the beginning of the semester for potential conflicts** between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at https://odos.illinois.edu/community-of-care/resources/students/religious-observances/ to request appropriate accommodations. **This should be done in the first two weeks of classes.**

## A few more words from your instructors

Do not hesitate to approach the instructors for any concerns you might have relevant to the class. Please note:

1. As a matter of principle and fairness, we never revise grades unless in these rather rare occasions, when an obvious grading omission or numerical error in calculating a grade has occurred.
2. If you have circumstances that you worry will affect your grade, the time to talk to your instructor about it is **early and during the semester**. There is nothing anyone can do at the end of the semester, no matter how willing they are to help.
3. If you claim special circumstances (such as illness) to ask, for example, for a late submission, you need to provide valid proof.
4. The on-line features of the class offer you a rich learning environment. Occasionally, we might encounter a bug. Let us know if you have come across such errors and we will take care of this as fast and as efficiently as possible. ***Always keep neat records of your complete assignment solutions, so that we can check them manually, if needed. This is also a good habit because you develop a complete record of problems you have solved, for review purposes, before exams.***

**Inclusivity and mutual respect**

We intend this class to provide a welcoming and safe learning environment for everyone, regardless of individual characteristics, appearance, beliefs, preferences, culture, genetics, and any other constructs that can make us lose sight of our common nature. In all ways that really matter, we are all similar: intelligent life inhabiting the only known planet that can support life for us.

Similarly, we strive to accommodate students with different technical content backgrounds. Some students might have seen the material before. Some might be R pros already, while some might have never coded before. It does not matter where you start entering the class. What matters is what you know at the end of the semester.

We have made an intentional effort to make our materials accessible to students of different backgrounds and we offer help for the students who need extra help. But we need you to be active in this effort!

* If you are a pro on something, do not distance your ‘pro’ selves from the class community! You can support your teammates’ learning journey by not being a ‘I know it all, I do it all myself’. Help others see how they can do things and let them do things.
* If you are a newbie, never feel intimidated! Do feel determined to learn! You need to be active responders to our ‘stimuli’ (questions, class work, homeworks, practice problems, office hours). Seek feedback and learn how to accept and use it.
* Feedback is not criticism. Understanding the importance of feedback and taking advantage of feedback are valuable skills.
* We are here to support your learning journey, as long as you also keep present and open to learning, in every step! Leaving this (any) class, you should feel that you have become a more accomplished person in **both** social/professional skills and technical skills, compared to where you started.

## Office hours



## Schedule of Classes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***TOPICS, CORRESPONDING READING SECTIONS IN TEXTBOOK AND WORKSHEET NUMBERS (#)*** | Homeworks (assigned and due on Tuesdays) | Team project (assigned and due on certain Thursdays) | Due Dates | Exam dates |
| **Week 1** (8/27/2024 and 8/29/2024) Introduction to class and its toolbox.Introduction to R. ***#1*** | Homework 1(R practice) |   |  |  |
| **Week 2** (9/3/2024 and 9/5/2024) Set Theory, Venn Diagrams, Sample space, Events; Counting sample points (permutations, combinations); Probability axioms. ***#02, 02R, 03, 03R*** | Homework 2 |  | Homework 1 due, Tuesday before class |  |
| **Week 3** (9/10/2024 and 9/12/2024) Conditional probability; Total Probability; Bayes' theorem.R practice. ***#04, 04R***  | Homework 3 |  | Homework 2 due, Tuesday before class  |  |
| **Week 4** (9/17/2024 and 9/19/2024) Random Variables; Discrete & Continuous Probability Distributions.***#5, Review for exam 1*** | Homework 4 |   | Homework 3 due, Tuesday before class | Exam 1 (starting Sep. 20 in CBTF) |
| **Week 5** (9/24/2024 and 9/26/2024)Joint probability distributions, marginal and conditional distribution. Mathematical expectation -Mean, Variance, Covariance, and Correlation.Linear combination of Random Variables (function of multiple random variables). (Error propagation)***#06, 07***  | Homework 5 |  | Homework 4 due, Tuesday before class |  |
| **Week 6** (10/1/2024 and 10/3/2024) Discrete probability distributions, Uniform, Binomial, Hypergeometric.Negative Binomial, Geometric, Poisson; Return period.***#08, 09*** | Homework 6 |  | Homework 5 due, Tuesday before class |  |
| **Week 7** (10/8/2024 and 10/10/2024) Continuous probability distributions, uniform, normal.**#10*, Review for exam 2*** | Homework 7 |  | Homework 6 due, Tuesday before class | Exam 2 (starting Oct. 11 in CBTF) |
| **Week 8** (10/15/2024 and 10/17/2024) Continuous probability distributions, lognormal, gamma family; Sampling distributions.***#*11, *12*** | Homework 8 | Team Project – part 1 | Homework 7 due, Tuesday before class |  |
| **Week 9** (10/22/2024 and 10/24/2024) Central Limit Theorem.Visualizing data: histograms, box and whisker plots; Point estimation.***#13, 14*** | Homework 9 | Team Project – part 2 | Homework 8 due, Tuesday before class Project part 1 due, Thursday before class |  |
| **Week 10** (10/29/2024 and 10/31/2024) Confidence intervals. One and two sample estimation; Estimating the mean, estimating proportion.***#15, Review for exam 3*** | Homework 10 |  | Homework 9 due, Tuesday before noon  | Exam 3 (starting Nov. 1 in CBTF) |
| **Week 11** (11/05/2024 and 11/07/2024) Confidence intervals, paired test for the means, population proportion.Hypothesis testing introduction–Type I and II errors.***#16, 17*** |  |  | Project part 2 due, Thursday before class  |  |
| **Week 12** (11/12/2024- 11/14/2024) Hypothesis testing –one and two-tailed Tests. Hypothesis testing one and two populations; Goodness of fit.***# 18, 19*** | Homework 11 | Team Project – part 3 |  |  |
| **Week 13** (11/19/2024 and 11/21/2024) Simple linear regression (SLR) and correlation. Hypothesis testing and inferences for SLR, correlation coefficient; Residual analysis. ***# 20, 21***  |  |  | Homework 10 due, **Tuesday** before class |   |
| **Fall break** |
| **Week 14** (12/3/2024 and 12/5/2024) Error propagation.***#22, Review for exam 4*** |  |  | Homework 11 due, **Tuesday** before class | Exam 4  (starting Dec. 06 in CBTF) |
| **Week 15** (12/10/2024 only)Working on project |  |  | Team project part 3 due Friday Dec 13 by noon |  |

1. Note that review sessions (Thursdays before exams) do not count for attendance. [↑](#footnote-ref-1)