IE 300 – Analysis of Data

Section B, Spring 2022

Course information

Credit hours: 3
Instructor: Chrysafis Vogiatzis
Pronouns: He/him/his
Email: **chrys@illinois.edu**
Course website: **canvas.illinois.edu**
Office: 211 Transportation Building
Office hours link: **https://tinyurl.com/yxqdm847**
Office hours: **M 4pm–5pm,**
W 4pm–5pm,
F 1.30pm–3pm.
and by appointment

If the link to my office hours is not working as intended, please use the following details:

Meeting ID:	450 021 1406
Password:	069901

Meeting times

Component	Section	Meeting time	Meeting place
Lecture	BL1	MWF, 10.00 am–10.50 am	112 Transportation Building
Labs	BD1	M 11.00 pm–11.50 am	L440 Digital Computer Laboratory
	BD2	T 3.00 pm–3.50 pm	1001 Mechanical Engineering Laboratory
	BD3	W 9.00 am–9.50 am	L440 Digital Computer Laboratory
	BD4	R 10.00 am–10.50 am	L440 Digital Computer Laboratory

During the first week of classes, please note that all lectures will be online. The link to attend the online lectures during the first week (and whenever necessary to move class online) is

https://illinois.zoom.us/j/89381900810?pwd=ZEZVOFh6Zzh4SFhtU2VjSkJMRC9qdz09

If the link to the lecture is not working as intended, please use the following details:

Meeting ID:	893 8190 0810
Password:	801370

Course communication

All communication of announcements, assignments, and other materials will be done through the course website on **Canvas**. You can also email the instructor and teaching assistants; when doing so, please begin your email subject line with [IE 300]. This helps with class organization and will ensure a faster reply. Finally, please use the **Piazza** website for IE 300 to ask questions and participate in discussions. The link to **Piazza** is here: **piazza.com/illinois/spring2022/ie300**.

Teaching assistants

The teaching assistants for Spring 2022 are (in alphabetical order):

- **Seyoung Park**;
- **Reza Soleymanifar**;
- **Setareh Taki**.

Textbook

Applied Statistics and Probability for Engineers by Douglas Montgomery and George Runger, 7th ed. (5th or 6th editions will also work), ISBN-13: 978-1119231943, ISBN-10: 1119231949.

The textbook is **highly recommended**, but not required. **I will provide you with everything you need to be successful** in the class (lecture notes, videos, exercises, practice problems, codes). For an example of how the notes look like, please visit my personal website at http://vogiatzis.web.illinois.edu/ie300.html.

Course description

This course is intended to be an introduction to and survey of probability models and statistical analysis of data. A student should complete this course with the ability to understand how probability distributions model experiments with uncertain outcomes, and how to analyze these experiments by applying statistical methods to observed outcomes.

Prerequisites

MATH 241 Calculus III – Required.

Learning outcomes

Upon completion of the course and all of its topics, students should have the abilities and tools to:

- understand and quantify the role of uncertainty in engineering models and data [1,2,6];
- understand and successfully apply probability concepts in the development of engineering models and the analysis of engineering data [1,2,6];
- identify and use proper discrete and continuous random variables and their distributions [1,2,6];
- formulate and conduct statistical analyses and experiments of observed data to reach statistically sound conclusions [1,2,6];
- perform statistical analyses using proper Python packages and software [1,2,6].

Note: ABET outcomes $1, 2, 6$ that are covered with the course are (for more information, please visit https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2019-2020/#GC3):

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Exams

There are **four exams** in the class: three midterm exams and a final exam. The three midterms will be testing the material covered in the first, second, and third parts of the class, respectively (see the Calendar section). The final exam will be cumulative and will be given (as designated by the University of Illinois) on the date shown here: https://registrar.illinois.edu/faculty-staff/final-exam-scheduling/final-exam-schedule/.

The three midterm exams will be announced in class at least one week before they are scheduled to take place. At the moment, they are scheduled to take place on or near February 16, March 25, and April 22.

Make-up exams will **only** be provided if notified at least three days prior to the exam date. In the case of an emergency, a make-up exam will be provided with the proper and appropriate documentation justifying your missed exam. The make-up exam will be offered no later than one week from the date of the exam.

Quizzes

There will be 12-15 quizzes throughout the course of the semester. All quizzes will be announced one class before the quiz is set to take place. An announcement before every quiz will also be posted on the class website. Information specific to each quiz (topics, format) will be announced as needed before every quiz. All quizzes will take place on **gradescope** (use access code: N8BR45). The two lowest quiz grades of every student will be dropped. No make-up quizzes will be offered at any point in the semester.

Worksheets

Almost every lecture we will have will require you to fill in and submit a worksheet. All worksheets will be submitted through **gradescope** (use access code: N8BR45). Worksheets will be announced one hour before the lecture time and will need to be submitted within 24 hours. Ideally, you will finish and submit your worksheet by the end of the lecture time! You are allowed and encouraged to work with other students in the class; however every student needs to submit their own work. Copying the work of someone else violates the honor code and is not allowed.

Case studies

Case studies will be studied during the lab sessions throughout the semester. Students are expected to work in groups of 3-4 (but can choose to work by themselves if they so prefer) and submit a

written report together for each of the case studies. All students of a group will receive the same grade for a submitted report. The case studies will often require you to use Python. The teaching assistant of your lab and the instructor of the class will both be available to help you get used to coding in Python. When submitting your report, create a compressed folder that contains a text document (your report) and the Python code you wrote. More details on submitting your case study reports will be provided during the semester. Seeing as this is a group assignment, no late submissions will be accepted.

Re-grade policy

If you believe that an exam, quiz, or homework assignment was graded incorrectly, please reach out to me at the latest one week after the announcement of the result. In your email requesting the re-grade, please add an explanation of where and why a re-grade is desired. You may also use the re-grade option through gradescope.

Attendance

While attendance is not mandatory, it is highly recommended. Students will be responsible for all of the material in the pre-lecture videos, in the notes, and in the worksheets. Important discussions and activities will take place during lecture time. If you are in a different time zone, please let me know and we will make arrangements for you to get time with us for discussions in a suitable time.

General class policies

- Be courteous and kind to others (including me!). Please stay kind, flexible, and supportive to the people around you.
- I will prioritize supporting you, sharing all resources with you early and often, and communicating expectations and opportunities clearly. We did not sign up for COVID-19 and the way it has upended our lives, so I will make sure to stay flexible and allow you the space and time to grow.
- If participating online, please mute your microphone, if not asking a question or actively participating in a discussion.
- Some lectures will be recorded: my goal is to also record all lab sessions. If you have an issue with having your questions or participation recorded, please contact me and we will address this.
  - The recordings will only be made available to you through Canvas.

Grading policy

A: $[93, 100]$, A-: $[90, 93)$, B+: $[87, 90)$, B: $[83, 87)$, B-: $[80, 83)$, C+: $[77, 80)$, C: $[73, 77)$, C-: $[70, 73)$, D+: $[67, 70)$, D: $[63, 67)$, D-: $[60, 63)$, F: $[0, 60)$.

Worksheets	Quizzes	Case studies	Exam 1	Exam 2	Exam 3	Final exam	**Total**
10%	10%	10%	15%	15%	15%	25%	**100%**

Class topics

- Basic probability theory (textbook chapters 1 and 2).
  - Basic notation and definitions;
  - Counting rules;
  - Axioms of probability;
  - Conditional probabilities;
  - Independence and law of total probability;
  - Bayes' rule.
- Joint probability distributions (textbook chapter 5).
  - Joint probability distributions;
  - Marginal and conditional distributions;
  - Covariance, correlation, and independence;
  - Common joint distributions.
- Hypothesis testing (textbook chapters 9 and 10).
  - Formulating hypotheses;
  - Errors;
  - Statistical conclusions and p-values;
  - One-sample hypothesis tests;
  - Two-sample hypothesis tests.
- Other topics (time permitting, textbook chapters 12 and 13).
  - Multiple linear regression;
  - Analysis of variance.
- Discrete and continuous random variables (textbook chapters 3 and 4).
  - Definitions;
  - Probability mass functions and cumulative distribution functions;
  - Common discrete and continuous distributions;
  - Expectations and variances.
- Basic statistics (textbook chapters 6, 7, and 8).
  - Definitions and examples;
  - Populations and samples;
  - Sample means and variances;
  - Estimation and the central limit theorem;
  - Methods of point and interval estimation;
  - Common confidence intervals;
  - Tolerance and prediction intervals.
- Linear regression (textbook chapter 11).
  - Formulating linear regression models;
  - Least squares for parameter estimation;
  - Confidence intervals;
  - Hypothesis testing on linear regression model parameters.

Calendar

While we will do our best to adhere to the calendar, I will be flexible and do extra reviews or spend more time on specific topics, if need be. That said, the following calendar should help you be prepared for what is coming early. I will be posting announcements throughout the semester with the material we are bound to see every week.

Week	Lecture	Topic	Quiz
	-	No class (MLK day)	
Week 1	0	Class introduction	
	1	Random experiments, sample spaces, events	
	2	Counting rules	Quiz 1
Week 2	3	Basic probability theory	
	4	Bayes' theorem	
	-	Q&A session on Bayes' theorem	Quiz 2
Week 3	5	Discrete random variables	
	6	Discrete random variables	Quiz 3
	7	Continuous random variables	
Week 4	8	Continuous random variables	
	9	Expectations and variances	Quiz 4
	-	Exam 1 review	
	-	**Exam 1**	
	10	The central limit theorem	
	-	Q&A session on CLT	Quiz 5
Week 6	11	Jointly distributed random variables	
	12	Joint distributions: extensions	Quiz 6
	13	Joint distributions: common distributions	
Week 7	-	Q&A session on joint distributions	
	14	Descriptive statistics	Quiz 7
	15	Point estimators	
Week 8	17	The method of moments	
	18	Maximum likelihood estimation	Quiz 8a
	-	**SPRING BREAK**	
Week 9	-	**SPRING BREAK**	
	-	**SPRING BREAK**	
	19	Bayesian estimation	Quiz 8b
Week 10	-	Exam 2 review	
	-	**Exam 2**	
	20	Confidence intervals	
Week 11	21	Confidence intervals	
	22	Confidence intervals activity	Quiz 9
	23	Confidence intervals on two populations	
Week 12	24	Introduction to hypothesis testing	
	25	Proportion hypothesis testing	Quiz 10
	26	Hypothesis testing for means and variances	
Week 13	27	Hypothesis testing for variances	
	28	Hypothesis testing for means of two populations	Quiz 11
	29	Hypothesis testing for variances and proportions	
Week 14	-	Exam 3 review	
	-	**Exam 3**	
	30	Linear regression	
Week 15	31	Multiple linear regression	Quiz 12
	32	Significance of regression	
Week 16	33	Regression extensions	Quiz 13
	-	Final exam review	
	-	**Final exam**	

Sexual Misconduct Reporting Obligation

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 Office. In turn, an individual with the Title IX 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: wecare.illinois.edu/resources/students/#confidential. Other information about resources and reporting is available here: wecare.illinois.edu.

Academic Integrity

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: https://studentcode.illinois.edu/article1/part4/1-401/. 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.

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.

Disability-Related Accommodations

To obtain disability-related adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217.333.4603, email disability@illinois.edu, or go to the DRES website (at http://disability.illinois.edu).

If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

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.

Updates to the syllabus

The contents of the syllabus and the policies described are subject to change. If that happens, all the changes will be announced and described on the course website. A summary of the changes will be offered in this page, too.

Prepared by:	Chrysafis Vogiatzis
Last updated:	January 17, 2022
Major changes:	Teaching assistants added.