NUMERICAL METHODS IN ENVIRONMENTAL SCIENCE, 3 CREDITS
11:375:303:01
FALL 2024

COURSE INSTRUCTOR AND CONTACT INFORMATION

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Communication preferences:
- For questions related to the course materials, you must use the discussion board on Canvas. This allows everyone to learn from the questions and answers from other students, and my own responses on the discussion board.
- For personal matters, please email me and indicate the course code in the subject line of your emails to me.
- I will reply within 2 business days.

COURSE MEETING DAYS, TIMES, LOCATION, MODALITY

Tuesdays	8:30 AM – 9:50 AM	ENR-323	In-person
Fridays	8:30 AM – 9:50 AM	ENR-323	In-person

The ENR building is at 14 College Farm Rd, New Brunswick, NJ 08901-8551
Room 323 is on the 3rd floor, in the middle of the building. It is a room with computers.
Course site: https://canvas.rutgers.edu/

OFFICE HOURS / STUDENT SUPPORT HOURS

A weekly office hour will be scheduled by a poll once the semester starts.

Office hours are not required: they consist of a time the instructor set aside to meet with students, without prior appointment. Consider them as student support hour. We can discuss the course material, study habits and organization, graduate school, etc.

COURSE DESCRIPTION

Formulation and solution of environmental science problems by applying analytical, statistical and numerical techniques. Principles of data analysis. Generation and solution of mass and energy balances.
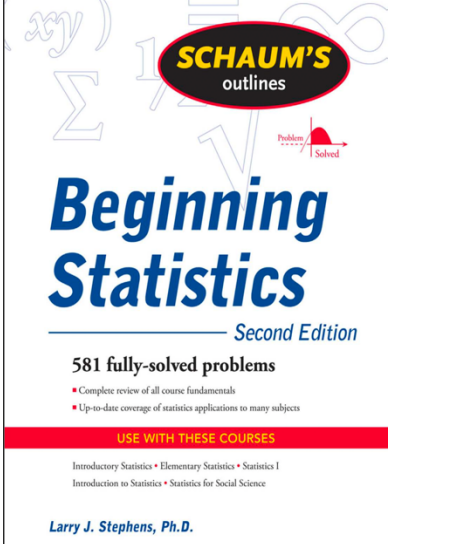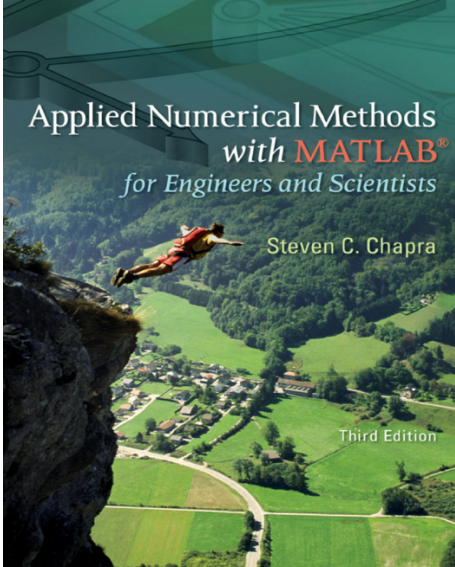
Prerequisite: 01:640:135 or 151.

REQUIRED TEXTS AND COURSE MATERIALS

There are no required texts.

Recommended materials (you can use prior editions as well):

	SCHAUM'S OUTLINE OF BEGINNING STATISTICS Stephens, Larry J Second Edition, 2009 Publisher: McGraw-Hill Education ISBN: 9780071635332 ISBN: 0071635335
	APPLIED NUMERICAL METHODS WITH MATLAB FOR ENGINEERS AND SCIENTISTS Chapra, Steven C. 2005 Publisher: McGraw-Hill Higher Education ISBN : 0072392657 (acid-free paper) ISBN : 0072976772 (set)

OPENINTRO STATISTICS
AVAILABLE ONLINE HTTPS://WWW.OPENINTRO.ORG/BOOK/OS/

OpenIntro Statistics

OpenIntro Statistics is a dynamic take on the traditional curriculum, being successfully used at Community Colleges to the Ivy League

all videos slides labs other

OpenIntro Statistics is recommended for college courses and self-study.

Getting Started

Amazon KDP raised book print prices by ≈40% in mid-June, and they also subsequently removed free shipping from our books by pushing the minimum free shipping price up to $35 from what had been $25 (our account appears to be in the early phase of this price hike rollout, so others should expect to see this change rolled out to them soon). These changes will net Amazon over $50,000 per year from sales on OpenIntro books alone, and we expect that OpenIntro will lose money as a result of reduced sales.

TECHNICAL / TECHNOLOGY REQUIREMENTS

Regularly, you will need to use a computer in class. You can use the class computer or bring your personal laptop computer.

You will need:
- o Scientific calculator
- o MS Excel (on your personal computer or the classroom computer)
- o An internet connection: we will use Colab, an online tool to code in R and Python, both in class and assignments. Please, connect with your Rutgers Scarlet email (not a personal gmail address): https://colab.research.google.com/#

Note that connecting to internet in ENR323 can sometimes be difficult, especially the first time. If you're having issues, first try to connect from the faculty mail space (2nd floor, in from of Chair's office), where there is the main router. If you still have trouble, contact Rutgers IT help desk.

LEARNING GOALS

Course Learning Goals

By fully participating in this course, students will be able to:
- Formulate and solve environmental science and engineering problems by applying numerical and statistical tools and techniques.
- Apply ethical principals in generating, reporting, and analyzing.

The Environmental Science Undergraduate Program learning goals addressed in this course are:
- Apply knowledge, skills and techniques from the sciences and mathematics to identify, characterize and provide solutions to environmental problems.
- Design and conduct experiments, analyze and interpret data to draw informed conclusions.
- Recognize and discuss the ethical and professional responsibilities of environmental scientists in addressing contemporary environmental science issues and the impact of environmental science in a global and societal context.

The Environmental Engineering Undergraduate Program student outcomes addressed in this course are:
- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

GRADING & ASSESSMENT

Homework assignments & participation	10%	Due dates provided on canvas
Exam 1	25%	
Exam 2	25%	
Exam 3 (final exam)	40%	

Homework assignments:
- To be submitted on canvas as per instructions given in each assignment.
- The assignments will not be graded. The assignment grade is therefore a participation grade. Submission on time guarantees the full grade. Each assignment will be weighed an equal proportion of the total weight of the "Homework assignments & participation" category. 2% are for participation to TopHat quizzes and online discussion board. The rest will be distributed equally on the assignments. For example, if we do a total of 8 assignments, each will be worth 1%.
- Late policy: no late assignments will be considered.

Exam 1 will cover all the material covered from the start of the course.

Exam 2 will cover all the material covered from the start of the course with an emphasis on material covered since Exam 1.

Exam 3, i.e. the final exam, will cover all the material covered from the start of the course.

TENTATIVE SCHEDULE OF TOPICS

This is subject to change. An updated tentative schedule of topics is posted on Canvas.

Lecture	Topic	Reading
1	Introduction, pre-test, frequency distribution in one variable	Schaum Ch. 1 & 2
2	Frequency distribution in one variable (cont.), Using Excel and Colab for Python and R	Schaum Ch. 1 & 2
3	Central tendency measures, dispersion, outliers	Schaum Ch. 3 & 4, Diez Ch. 7.3
4	Hypotheses, comparison of means, t-test	Schaum Ch. 9 & 10
5	Analysis of variance (ANOVA), F-test	Schaum Ch. 12, Diez Ch. 5
6	Chi-square	Schaum Ch. 11
7	Ethics and Professionalism	Guest Lecture
8	**Exam 1**	
9	Elementary linear regression, correlation	Schaum Ch. 13, Diez Ch. 7
10	Zero- and first-order reaction rate equations	Lecture notes
11	Rate-limiting functions (Langmuir isotherm)	Lecture notes
12	Power function (Freundlich isotherm)	Lecture notes
13	Multiple linear regression	Chapra Ch. 15.2
14	Numerical solutions of non-linear algebraic equations	Chapra Ch. 6
15	Linear Algebraic equations and matrices	Chapra Ch. 8

16	Matrix inversion	Chapra Ch. 11
17	Matrix inversion – Application to multiple linear regression	Chapra Ch. 11
18	Matrix inversion – Finite section water quality mass balance models	Chapra Ch. 11
19	**Exam 2**	
20	Solving differential equations using Euler's method & applications to hydrological models	Chapra Ch. 22
21	Solving differential equations using Euler's method & applications to hydrological models	Chapra Ch. 22
22	Solving differential equations using Euler's method & applications to hydrological models	Chapra Ch. 22
23	Solving differential equations using Euler's method & applications to hydrological models	Chapra Ch. 22
24	Fourier series analysis – applications to periodic step function	Chapra Ch. 16 and lecture notes
25	Fourier series analysis – applications to periodic step function	Chapra Ch. 16 and lecture notes
26		No class, day after Thanksgiving
27	Environmental Engineering Economics, Cost-benefit analysis	Lecture notes
28	Environmental Engineering Economics, Cost-benefit analysis	Lecture notes
29	Review	
	Exam 3 = final exam	

POLICIES

Attendance and Participation

I will not record attendance. However, if you miss a participation quiz in class, you'll lose the participation point for that day.

We will use TopHat in class. Always connect using your Rutgers email.

Disability Accommodations

Students in need of disability accommodations should register for accommodations and consult the policies and procedures of the Office of Disability Services website: https://ods.rutgers.edu

ACADEMIC INTEGRITY POLICY

University website on Academic Integrity: http://nbacademicintegrity.rutgers.edu/

Rutgers University takes academic dishonesty very seriously. By enrolling in this course, you assume responsibility for familiarizing yourself with the Academic Integrity Policy and the possible penalties (including suspension and expulsion) for violating the policy. As per the policy, all suspected violations will be reported to the Office of Student Conduct. Academic dishonesty includes (but is not limited to):

- *Cheating*
- *Plagiarism*
- *Aiding others in committing a violation or allowing others to use your work*
- *Failure to cite sources correctly*
- *Fabrication*
- *Using another person's ideas or words without attribution, including re-using a previous assignment*
- *Unauthorized collaboration*
- *Sabotaging another student's work*

If you are ever in doubt, consult your instructor.

STUDENT SUPPORT AND MENTAL WELLNESS

- Student Success Essentials: https://success.rutgers.edu
- Student Support Services: https://www.rutgers.edu/academics/student-support
- The Learning Centers: https://rlc.rutgers.edu/
- Rutgers Libraries: https://www.libraries.rutgers.edu/

- Bias Incident Reporting: https://studentaffairs.rutgers.edu/bias-incident-reporting
- Dean of Students – Student Support Office: https://success.rutgers.edu/resource/dean-students-student-support-office
- Office of Veteran and Military Programs and Services: https://veterans.rutgers.edu
- Student Health Services: http://health.rutgers.edu/
- Counseling, Alcohol and Other Drug Assistance Program & Psychiatric Services (CAPS): http://health.rutgers.edu/medical-counseling-services/counseling/
- UWill: free immediate access to teletherapy; you can choose a therapist based on your preferences including issue, gender, language, ethnicity. http://health.rutgers.edu/uwill/
- Office for Violence Prevention and Victim Assistance: www.vpva.rutgers.edu/
- Office of Disability Services: https://ods.rutgers.edu/
- Basic Needs Assistance (food, housing, and other essentials): https://ruoffcampus.rutgers.edu/basic-needs
- Rutgers Student Food Pantry: https://ruoffcampus.rutgers.edu/food-pantry