Seismic Hazard and Risk Analysis

Course websites and tools

This course will be facilitated online through Canvas (`canvas.stanford.edu`). We will use Ed Discussion for Q&A and discussions, and will use GradeScope for homework submission and grading. Both of these tools are accessible via links from the Canvas site.

Course meeting times and schedule

Lectures and discussions will be on T/Th, 8:30 - 10:20 am.

See this link for a schedule of topics and assignments:

`https://docs.google.com/spreadsheets/d/14asQXVdeoP3BgZ0NwPnWveSjsrGsQqarKgU8_hml4zQ`

Teaching team

Instructor
Jack Baker
Y2E2 283

Office hours:
T/Th 10:30 am - 12:00 pm

Course Assistants
Tyler Rodrigues
Kimberly Wong

Office hours:
Mon 3:30 PM to 5 PM, in Blume 127
Wed 3:00 PM to 4:30 PM, in Y2E2 B21

Office hours are a productive and enjoyable way to engage with you. We hope you will attend regularly!

Electronic correspondence should generally take place on the Ed Discussion tool, so the entire teaching team can see your inquiries and all students can see questions and respond with ideas. Please write us there with questions or requests. You can use Anonymous posts if you prefer to hide your name from other students, or private posts for issues unique to you. For confidential items, feel free to e-mail Prof. Baker at bakerjw@stanford.edu.

Textbook

Baker, J. W., Bradley, B. A., and Stafford, P. J. (2021). Seismic Hazard and Risk Analysis. Cambridge University Press, Cambridge, England.

The course will closely follow the notation, examples, and ordering of topics in this book, so it will be a useful supplemental resource. You can get a free electronic copy of the book at `https://stanford.idm.oclc.org/login?url=https://doi.org/10.1017/9781108425056`

Learning objectives

This course will introduce graduate students to the principles and procedures behind seismic hazard and risk analysis. By the end of this class, you will be able to:

- Utilize observed data to define sources of potential future earthquakes and their potential future activity rates.
- Utilize ground motion models to predict shaking intensity resulting from potential future earthquakes.
- Describe the benefits of observational data and numerical simulations for predicting ground motion shaking intensity.
- Perform probabilistic seismic hazard analyses, including target response spectra and disaggregation metrics.
- Utilize building damage data to calibrate fragility functions.
- Perform seismic risk calculations, including the average annual loss for a single building, and the most probable conditions to cause a given consequence.
- Critically examine commercial seismic hazard and risk analysis reports, to interpret results and identify key assumptions and approaches.

Prerequisites

This course will assume a basic knowledge of probability concepts such as random events and random variables (equivalent to completing CEE 203). Brief videos summarizing required background knowledge are available at the following links:

1. Set theory: `https://youtu.be/BA0GXX_Un9g`
2. Total probability theorem: `https://youtu.be/JChmNGQ4PkQ`
3. Random variables: `https://youtu.be/3ydswAYdep8`
4. Joint distributions: `https://youtu.be/vGHTztxS2F0`
5. Moments and expectations: `https://youtu.be/XrW5iIj9mVo`
6. The normal distribution: `https://youtu.be/jj_WoJdijQY`

For those desiring additional background or a reference materials on these topics, the following book is excellent and cheap to purchase or free online at `https://searchworks.stanford.edu/view/11927193`.

- Benjamin, J. R. and C. A. Cornell (2014). *Probability, Statistics, and Decision for Civil Engineers*. Dover Publications, Mineola, New York.

Some experience with Matlab programming is also needed. Students with any questions regarding prerequisites should talk to the instructor.

Evaluation

Grades will be computed using the following weighting scheme:

Homework	30%
Midterm	30%
Final project	40%

Homework assignments will consist of calculations that develop understanding of the materials presented in class. A final project will evaluate your ability to synthesize and utilize concepts from throughout the class. The midterm will be similar to the homework in content and format, so if you can easily complete the homework assignments then you should be able to successfully complete the exams.

Homework policy

- Homework assignments are to be submitted on GradeScope by midnight on the due date listed on each assignment. Late homework will be penalized at a rate of 10% per day late. Homework submitted after the solutions have been provided will not be accepted.
- Some homework assignments will require computer calculations. It is suggested that these computations be done using Matlab. I will provide some example code for it, and we will be able to assist with it a bit. Matlab is free for students at `https://www.mathworks.com/academia/tah-portal/stanford-university-30569029.html`. Make sure to install the *Statistics and Machine Learning*, *Symbolic Math*, and *Optimization* toolboxes when you install Matlab. You are free to use other computer programs if you prefer, as long as you clearly document your work. All of the calculations are also feasible using Excel, though will be less efficient in some cases.
- Clearly explaining what you have done to solve a homework or exam problem is at least as important as obtaining a correct numerical result. Computer or calculator computations must be accompanied by appropriate documentation of how the computation was carried out. See Homework #1 for more details. If you are uncertain about what to include, contact the teaching team.

Honor code

It is expected that Stanford's Honor Code will be followed in all matters relating to this course. You are encouraged to meet and exchange ideas with your classmates while studying and working on homework assignments, but you are individually responsible for your own work and for understanding the material. You are not permitted to copy or otherwise reference another student's homework or computer code. If you have any questions regarding this policy, please contact Prof. Baker.

COVID considerations

We will comply with all University policies related to maintaining a safe learning environment. If you feel sick, *do not come to the live sessions*, even if you suspect you just have a cold or allergies. Please do this out of an abundance of caution and out of respect for your peers and the teaching team. We will provide recordings of class lectures to assist students with illness-related absences.

Respect for Diversity

It is my intent that students from diverse backgrounds, perspectives, and situations be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity in gender, sexuality, disability, age, socioeconomic status, ethnicity, race, religion, political affiliation, and culture. I acknowledge that there is likely to be a diversity of access to resources among students and aim to support all of you as best as I can. Please let me know ways to improve the effectiveness of the

course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

All people have the right to be addressed and referred to in accordance with their personal identity. Please indicate the name that you prefer to be called and, if you choose, identify pronouns with which you would like to be addressed. I will do my best to address you accordingly and support classmates in doing the same.

Students with disabilities

Students with Documented Disabilities who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend accommodations, and prepare an Accommodation Letter for faculty. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations (650-723-1066, `https://oae.stanford.edu/`).

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