CEE 296: Regional Seismic Risk Analysis and Risk Management

Course abstract: This course is aimed at students interested in rigorous modeling of earthquake impacts at a regional scale and data-driven design of risk management strategies. The first half of the course will focus on building computational tools to simulate earthquake shaking, damage to buildings and infrastructure, and the resulting social and economic losses. The second half of the course will explore how impact modeling relates to disaster recovery policy, infrastructure investment planning, and other aspects of disaster risk management. The class will include guest speakers from government institutions, the private sector, and academia working at risk modeling and planning/policy intersection. The students will also conduct a regional seismic risk analysis tailored to a specific risk management objective as part of a final project.

Schedule and location: Tuesday/Thursday, 9:45-11:15 am
Classroom: McMurtry Art Building, 360

Lecture attendance and expectations:
Students are expected to take an active role in learning by coming to our class meetings prepared and ready to collaborate with their classmates. All course details and materials will be posted on our Canvas course site, and all class meetings will be held in person.

Instructors:

Maryia Markhvida
Adam Zsarnoczay
Rodrigo Carneiro da Costa
Jack Baker

Course Assistant:

Office hours: office hours are times you can meet with your instructors to discuss the material being covered in class, homework, questions or concerns you might have, and other related issues. You can also schedule individual meetings with the instructors if necessary.

Course website: canvas.stanford.edu

Learning objectives:
This course will introduce graduate students to concepts and applications of seismic risk analysis on a regional scale. By the end of the class, students should be able to:

- Identify, understand, and carry out all steps of a regional seismic risk analysis
- Be familiar with the tools available and select appropriate methods and tools for regional risk assessment.
- Collect and integrate information from various sources and learn how to handle data scarcity.
- Examine outputs of the risk analysis that measure consequences beyond asset losses and learn to estimate casualties, socioeconomic consequences, and the regional recovery process.
- Use risk assessment outputs in decision-making and risk management strategy.
- Investigate how modeling choices along various steps in the regional risk assessment influence the results and their implication on decision-making.

Prerequisites:
This course is aimed at graduate-level students in Civil Engineering or Earth Sciences with previous experience with Performance-Based Earthquake Engineering. Students must have taken either CEE 288 or an equivalent. Students should also be familiar with coding (e.g., in MATLAB).

Evaluation and grading basis:
Students must submit all of the following deliverables throughout the course. The following percentages represent each deliverable's weight and should guide you on how much effort you should spend on each item. University guidance on best practices for evaluation this quarter is still evolving, so there may be minor adjustments to this guidance shortly:

Homeworks (3):	45%
Project proposal	5%
Project milestone:	10%
Final project presentation:	15%
Final project report:	25%

There will be three graded homework assignments throughout the course:

- HW 0: review of probabilistic seismic hazard analysis (not graded)
- HW 1: regional ground motion simulation
- HW 2: fragility functions and damage and loss simulation
- HW 3: distributed infrastructure and housing recovery

Homework policy:

The following are homework policies that the students should adhere to:

- Homework is to be done individually or in groups of two.
- Homework assignments are due on the specified date at 11:59 p.m. and should be submitted via Gradescope. If you are having trouble delivering the homework on time, please email the instructors before the homework deadline.
- If you haven't been added to the course on Gradescope, you can register using the Entry Code ER36RW at https://www.gradescope.com/.
- Late homework will be penalized at 10% per late day for up to five days. After five days, no grade will be assigned.
- All homework should be typed.
- Some homework assignments will require computer calculations. It is suggested that these computations be done using Matlab—the software package the instructors will support.
- Students can use other computer programs as long as the work is clearly documented. However, no homework starter packages will be provided for other programming languages.

Final project:

The final project is the primary outcome of this course. The objective of the final project is for students to design and implement a regional seismic risk assessment to inform a specific risk management action or strategy. The final risk metrics must include insights beyond financial losses (e.g., casualties, temporarily displaced population, shelter needs) and inform an action or policy recommendations based on the risk assessment results. Students are expected to work in groups of 2-3.

Honor code:

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

Tentative schedule:
The following schedule is a rough guide to help you anticipate your workload. The schedule for homework assignments and topics may change slightly depending on the pace of lectures.

Week	**Topic**	**HW**	**Project**
Week 1	Introduction to regional seismic risk analysis and disaster risk management	HW0 out	Project description out
Week 2	Seismic regional risk analysis framework Overview of hazard analysis	HW1 out	Project proposal due
Week 3	Regional hazard analysis; Exposure modeling		
Week 4	Exposure modeling continued; Modeling damage	HW1 due HW2 out	
Week 5	Modeling damage continued		Project milestone due
Week 6	Immediate consequence modeling; Community resilience and long-term consequence and recovery modeling	HW2 due HW3 out	
Week 7	Housing recovery and distributed infrastructure modeling		
Week 8	Economic and business impact modeling; Disaster risk assessment and management in the developing context	HW 3 due	
Week 9	Risk assessment and other hazards; Guest lecture on risk modeling and disaster risk management in practice		
Week 10	Project presentations Course wrap-up		Project presentations/ Project report due