New York University Tandon School of Engineering
Center for Urban Science and Progress
Department of Civil and Urban Engineering

SPRING 2022
CUSP-GX 8006 (CE-GY 7993) DISASTER RISK ANALYSIS AND URBAN SYSTEMS RESILIENCE

Instructor: Prof. Luis Ceferino. E-mail: ceferino@nyu.edu
Course Assistant: TBD
Schedule: Mondays 11 am – 1:30 pm
Location: TBD

Course Description:

This course offers ample coverage of urban risks to different natural hazards such as earthquakes, hurricanes, floods, and wildfires. The class will discuss fundamental concepts in understanding hazards, infrastructure vulnerability, risk, and disaster recovery. Additionally, the course will cover introductory topics on disaster risk modeling with rigorous statistical methods and large datasets. The class will review critical elements that can exacerbate risks such as climate change, rapid urban growth, and deteriorating and precarious infrastructure. The course will include guest speakers who inform policymaking on large-scale risk mitigation and build novel technologies for disaster risk reduction. The class is designed for graduate students interested in risk and resilience for practice and research. Knowledge of undergrad-level statistics and probabilities is required. Experience in data visualization in Python, Matlab, or R to the level in class taught in class pre-requisite is recommended to take the most advantage of the class. The class will meet regularly for lectures and discussion of reading assignments on state-of-the-art quantitative and qualitative concepts of disaster risk and risk management. An open project in the field of disaster risk and resilience is a crucial component of the class.

Course Objectives:

1- Provide a thorough understanding of fundamental concepts of disaster risk: natural hazards, urban vulnerabilities, exposure, and risk.
2- Build introductory skillsets to state-of-art disaster risk modeling with an understanding of data requirements and existing limitations
3- Gain critical insights on factors and mechanisms that can increase urban risk to natural hazards, including urban growth processes and climate change
4- Develop skillsets for oral presentations on disaster risks and visualization of risk data.

Course Pre-requisite: CUSP-GX 5002 - Principles of Urban Informatics, or equivalent background in statistics and probabilities.

Grading:

Class Participation and regular presentations
Project Proposal
Progress Report I

Progress Report II
Final Report and Project Presentation

Office Hours:

Prof. Luis Ceferino: TBD
Course Assistant: TBD

LECTURE TOPICS:

Week 1: Introduction to Disaster Risk Analysis. Topics: Sendai Framework for Disaster Risk Reduction, natural hazards definition and overview, review of large disasters, definition of risk and resilience of urban systems, and review of basic statistical analysis.

Week 2: Disaster recovery continuum and risk management. Topics: Risk management cycle, recovery activities, risk analysis for enhancing resilience, risk management examples, review on basic probability analysis.

Week 3: Natural Hazards Part I – Introduction. Topics: Underlying physics of frequent natural hazards, hazards' frequency and intensity, introduction to their simulation through Monte Carlo.

Week 4: Natural Hazards Part II – Earthquakes. Topics: Earthquake ground shaking, data requirements and modeling assumptions for seismic hazards, uniform hazards and seismic hazard maps.

Week 5: Natural Hazards Part III – Hurricanes. Topics: Hurricane gusts, wind fields, data requirements and modeling assumptions for hurricane hazards, wind maps for infrastructure design.

Week 6: Modeling vulnerabilities Part I – Introduction. Topics: Vulnerability curves, fragility curves, methods for developing vulnerability curves, introduction to reliability analysis.

Week 7: Modeling vulnerability Part II – Buildings. Topics:

Week 8: Modeling vulnerability Part III – Urban systems.

Week 9: Urban exposure to natural hazards.

Week 10: Multi-scale risk analysis Part I – Methodology and metrics for urban resilience. Topics: uncertainty,

Week 11: Multi-scale risk analysis Part II –Increasing Risks and Risk Tools: Markov Models

Week 12: Climate change effects on urban risk to natural hazards.

Week 13: Social vulnerabilities and their role in urban risks.

Week 14: Regional policies and novel technology for disaster risk reduction.

Week 15: Final presentations

Logistics for readings:

Students will read the assigned reading material. Then, the students will prepare 10-minute presentations in groups of three in a rotating manner, so there is a group presenting the material each class. The presentation should summarize the reading material and finalize with two to three questions to stimulate further discussion on the topic. The reading material will be uploaded to NYU Brightspace.

Project ideas:

- Assessing building and infrastructure damage after disasters using computer vision and photographs
- Hyper-resolution mapping of impacted communities to sea level rise
- Combining urban growth models with risk assessment
- Mapping critical infrastructure exposed to risks
- Assessing the viability of solar panels for power system resilience
- Using novel datasets for mapping disaster recovery
- Virtual reality for communicating disaster risk and emergency response training

Diversity Statement

The NYU Tandon School values an inclusive and equitable environment for all our students. I hope to foster a sense of community in this class and consider it a place where individuals of all backgrounds, beliefs, ethnicities, national origins, gender identities, sexual orientations, religious and political affiliations, and abilities will be treated with respect. It is my intent that all 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. If this standard is not being upheld, please feel free to speak with me.

Moses Center Statement of Disability

If you are student with a disability who is requesting accommodations, please contact New York University's Moses Center for Students with Disabilities (CSD) at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 2nd floor.

NYU School of Engineering Policies and Procedures on Academic Misconduct

A. Introduction: The School of Engineering encourages academic excellence in an environment that promotes honesty, integrity, and fairness, and students at the School of Engineering are expected to exhibit those qualities in their academic work. It is through the process of submitting their own work and receiving honest feedback on that work that students may progress academically. Any act of academic dishonesty is seen as an attack upon the School and will not be tolerated. Furthermore, those who breach the School's rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the School's Policy on Academic Misconduct.

B. Definition: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:

1. Cheating: intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person's work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.

2. Fabrication: including but not limited to, falsifying experimental data and/or citations.

3. Plagiarism: intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.
4. Unauthorized collaboration: working together on work that was meant to be done individually.

5. Duplicating work: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission has been received from the course instructor(s) or research adviser involved.

6. Forgery: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.