

GP9573/HRR9573
Natural Catastrophes – Modelling, Assessing, and
Mitigating the Impact
Fall 2021

INSTRUCTOR:

Lecturer: Dr. Katsu Goda
Office: B&GS-1076; 519-661-2111 x 83189
E-mail: kgoda2@uwo.ca

DESCRIPTION:

Natural hazards and disaster risk reduction are an important and fast-evolving area of research and practice in Canada and globally. It is an interdisciplinary field that cuts across natural sciences (e.g., geophysics, geology, hydrology, and meteorology), applied sciences (e.g. structural and infrastructure engineering), data sciences (e.g. statistics and GIS spatial data analysis), and risk financing/management (e.g. insurance). This course introduces natural catastrophe modelling as a core technique. The course covers: (i) hazard identification and characterization, (ii) exposure modelling, (iii) vulnerability assessment, and (iv) financial risk quantification and management. The four key elements of natural hazard risks are integrated to quantify the risks of natural disasters to urban environments. The course content is suitable for graduate students who are enrolled in the collaborative graduate specialization in Hazards, Risks, and Resilience and for other graduate students who are in Earth Science, Statistical & Actuarial Sciences, Civil & Environmental Engineering, and Geography programs. This course involves computer programming with MATLAB. Hands-on start-up instruction for the use of MATLAB will be given.

PREREQUISITES:

N/A

LECTURE AND LAB SCHEDULE:

Lecture Thursdays, 9:30 am to 11:30 am (Lawson Hall 2210).
Computer lab Thursdays, 12:30 pm to 14:30 pm (Social Science Centre 1000 [computer lab]).
2 lecture hours, 2 laboratory hours, 0.5 course.

Students should check OWL (<http://owl.uwo.ca>) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class. Students are responsible for checking OWL on a regular basis. All course material will be posted to OWL: <http://owl.uwo.ca>. Any changes will be indicated on the OWL site and discussed with the class. If students need assistance, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800. Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently.

METHOD OF ASSIGNING FINAL GRADE:

There will be two assignments, and an individual project (oral presentation and written report). The ability to express ideas in a coherent and logical manner is an important factor in evaluation of assignments and tests.

Assignment I:	October 20, 2021 (Subject to change)
Assignment II:	November 20, 2021 (Subject to change)
Knowledge Test:	November 25, 2021 (Subject to change)
Project:	December 20, 2021 (Subject to change)
Final Grade:	Assignments - 40%, Test - 20%, Individual project - 40% (10% presentation and 30% written report)

TEXTBOOKS:

Natural Catastrophe Risk Management and Modelling – K. Mitchell-Wallace, M. Jones, J. Hillier, and Matthew Foote, Wiley, 2017. (Main textbook)

<https://www.wiley.com/en-ca/Natural+Catastrophe+Risk+Management+and+Modelling:+A+Practitioner's+Guide-p-9781118906040>

MATLAB Recipes for Earth Sciences – M. Trauth, Springer, 2015.

Available for download through Springer when connected to Western internet: 4th Edition

<http://link.springer.com/book/10.1007%2F978-3-662-46244-7>

Reliability of structures – A. S. Nowak and K. R. Collins, CRC Press, 2012.

Available in Taylor Library.

COURSE SCHEDULE:

- Lecture 1 Introduction to catastrophe modelling and its applications for disaster risk management and scientific computing and programming Using MATLAB.
- Lecture 2 Data analysis and probabilistic modelling (probability & statistics, probabilistic models, data analysis, and probabilistic modelling of random data and Monte Carlo simulation).
- Lecture 3 Anatomy of catastrophe model, Model input & output, and uncertainty in catastrophe models.
- Lecture 4 Natural hazards, general perspectives of hazard modelling, and overview of seismic hazard & risk.
- Lecture 5 Seismic hazard modelling (probabilistic seismic hazard analysis, earthquake occurrence in time and space, ground motions and seismic intensity measures, ground motion models, uncertainty modelling in PSHA, and Monte Carlo Simulation for PSHA).
- Lecture 6 Exposure modelling and basics of spatial data analysis.
- Lecture 7 General perspectives of vulnerability modelling, empirical vulnerability functions, analytical vulnerability functions).
- Lecture 8 General perspectives of financial modelling, financial seismic risk modelling, and extension of seismic hazard and risk analysis to other perils
- Lecture 9 Risk transfer and reinsurance/insurance industry, insurance and reinsurance, underwriting and pricing, capital modelling and catastrophe modelling, government schemes and insurance, insurance linked securities.
- Lecture 10 Multi-hazard risk assessment and disaster risk reduction & resilience

* Ten lectures will be given over a Fall term.

ASSIGNMENT PROBLEMS (Subject to change):

- Problem 1: Data analysis using a real earthquake catalog
- Problem 2: Generation of a stochastic event set from a simple seismic source model
- Problem 3: Ground motion regression analysis
- Problem 4: Simulation-based probabilistic seismic hazard analysis
- Problem 5: Generation of scenario shake maps.
- Problem 6: Global digital elevation models: SRTM versus TanDEM-X
- Problem 7: Seismic exposure analysis using WorldPop/METEOR data
- Problem 8: Empirical tsunami fragility analysis using the MLIT database
- Problem 9: Analytical seismic fragility modelling
- Problem 10: Risk assessment and financial calculations

POLICY STATEMENTS:

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

<http://www.uwo.ca/univsec/handbook/appeals/scholoff.pdf>

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. For further information please see:

<http://www.uwo.ca/univsec/handbook/appeals/medical.pdf>

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Student Health Services. The form can be found here:

https://studentservices.uwo.ca/secure/medical_document.pdf

Copyright Statement:

Please be aware that all course materials created by the instructor(s) are copyrighted and cannot be sold/shared. Those include materials used in midterms and finals. Any posting/sharing of such materials in part or whole without owner's consent is considered as violation of the Copyright Act and will be considered as a scholastic offence.

Support Services:

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on add/drop courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: <https://www.uwo.ca/sci/counselling/>.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at (519) 661-2147 if you have any questions regarding accommodations.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

Learning-skills counsellors at the Student Development Centre (<http://www.sdc.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help.

Additional student-run support services are offered by the USC, <http://westernusc.ca/services>.