

THE UNIVERSITY OF WESTERN ONTARIO - FACULTY OF ENGINEERING SCIENCE
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

CEE9520a – Application of Statistics and Reliability, Course Outline 2022-2023

Engineering systems are analyzed using probability theory and statistics to evaluate system performance under uncertainty. The course is focused on practical engineering problems and is designed to develop the student's appreciation for the application of uncertainty analysis methods in engineering design. Specifically, students will learn how to analyze and draw conclusions about system performance from statistical data relating to components of engineering systems, use Monte Carlo techniques and basic probabilistic and reliability methods to perform reliability analysis for engineering systems, analyze series and parallel systems, and make a decision under uncertainty. The practical problems will include, for example, consideration of uncertainty in the strength of materials, soil behaviour, and environmental loads acting on structures (wind loads, earthquake loads), and how these uncertainties are incorporated in design codes. The general topics are

- Analysis and interpretation of statistical data: data representation, descriptive measures of data, graphic representation of data;
- Analytical models for data analysis: discrete and continuous probability distribution function of one random variable, the continuous probability distribution of several random variables, the transformation of variables, distribution fitting (method of moments, method of maximum likelihood, and least-squares method), probability paper plots, tests for distributional assumptions, linear regression analysis.
- Reliability assessment of engineering system performance from component data: Application of central limit theorem for system analysis, calculation of system moments, response function, measure of system performance, first order the second-moment reliability analysis method, reliability index, the first order reliability method
- Monte Carlo techniques: general concept, methods for generating random values, sample size, and error bands.
- Design code calibration: Evaluation of load and resistance factors for target reliability levels.

Prerequisites:

None

Corequisites:

None

Antirequisites:

None

Contact Hours:

2 lecture hours per week (consult the department for the schedule)

Instructor:

Dr. H. P. Hong ESB3028; e-mail: hongh@eng.uwo.ca; *Secretary*: Room 3005

Textbook:

Prepared class notes should be brought to each class, and may be purchased at the UWO bookstore.

Other references:

Ang, A. H-S. and Tang, W. H. Probability concepts in engineering planning and design, Vol. I Basic Principles, John Wiley & Sons, Inc. New York, 1975.

Benjamin, J. R. and Cornell, C. A. Probability, statistics and decision for civil engineering, McGraw-Hill, Inc. New York, 1970.

Madsen H.P., Krenk, S. and Lind N.C. Method of Structural Safety, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1986.

Raiffa, H. Decision Analysis, Addison-Wesley, Reading, MA, 1968.

Thoft-Christensen, P. and Baker, M. J. Structural reliability theory and its application, Springer-Verlag, Berlin, Heidelberg, New York, 1982.

Units:

SI units will be used in lectures and examinations

Evaluation:

The final course mark will be determined as follows:

Assignments	20%
Project	20%
Final Examination	<u>60%</u>
Total	100%

Note:

Students must pass the final examination to pass this course. Students who fail the class participation and (quizzes) will be assigned the aggregated mark as determined above, or 48%, whichever is less.

Examination:

A final OPEN BOOK examination will be held on all work covered during the course. The date of the exam will be announced in the class at least two weeks prior to the exam.

Assignments and Project:

a) There will be four assignments. Each student must turn in one solution before the end of two weeks after the assignment is given.

b) Each student must turn in one written report on a project dealing with an engineering problem considering the application of random vibration. The report should not exceed 25 pages in double space including references, figures, and tables. The format of the report should follow the instruction to authors for the *Canadian Journal of Civil Engineering*.

Use of English:

In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Cheating:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

Attendance:

Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Conduct:

Students are expected to arrive at lectures on time and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

Sickness and Other Problems:

Students should immediately consult with the Instructor of the Department have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Notice:

Students are responsible for regularly checking their e-mail and notices posted outside the Civil and Environmental Engineering Department Office.

The attached document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.