

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

ES 9520a – Application of Statistics and Reliability, Course Outline 2012

Engineering systems are analysed 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 students' appreciation for application of uncertainty analysis methods in engineering design. Specifically, students will learn how to analyse and draw conclusions of 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, analyse series and parallel systems, and make 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, continuous probability distribution of several random variables, 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 second moment reliability analysis method, reliability index, first order reliability method
- Monte Carlo techniques: general concept, method 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

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 (purchase required)

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.

Hahn, G. J. and Shapiro, S. S. Statistical Models in Engineering, John Wiley & Sons, Inc. New York, 1967.

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.

Evaluation:

The final course mark will be determined as follows:

Assignments	25%
Project	25%
Final Examination	<u>50%</u>
Total	100%

Note:

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

Students who audit the course must attend 70% of the course and 70% of the assignments. Students who fail this criterion will be assigned the aggregated mark **F**.

Examination:

Final examination will be OPEN BOOK.

Assignments:

a) Four assignments: One solution to each of the assignments must be turned in by each student before at the end of the indicated date.

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 lecture 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 Department have any problem 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.