The Hong Kong University of Science and Technology
Department of Civil and Environmental Engineering

Course code Course title Instructors	CIVL 2160 Modeling Systems with Uncertainties Anthony Kwan LEUNG, Jize ZHANG
Prerequisites Credit	None 3
Textbook(s) and/or other materials	*Probability Concepts in Engineering, Emphasis on Applications to Civil and Environmental Engineering*, 2nd Ed., by Ang and Tang, published by John Wiley & Sons, Inc.
Course Objectives	1. Provide students with fundamental knowledge in uncertainty, probability and statistics 2. Identification and modeling of non-deterministic problems in civil engineering, and the treatment thereof as related to engineering design and decision making 3. Development of stochastic concepts and probability models, and their relevance to design and decision problems in various areas of civil engineering 4. Introduction to engineering problem solving involving inherent uncertainties via probabilistic modelling and statistical tools 5. Provide students with basic simulation skills to solve realistic engineering problems effectively
Topics	• Types and sources of uncertainty in engineering • Fundamentals of probability models • Random variables and probability distributions • Analytical models of random phenomenon • Choice of probability models • Multiple random variables and joint probability distribution • The Central Limit Theorem • Point estimation, confidence intervals and hypothesis testing • Regression and correlation analysis • Least squares methods • Software tools for rapid statistical computations
Computer usage	Computational software toolboxes allowed in second part of course
Lab Projects	No lab work required
Class/lab schedule	Two 80-minute lectures per week
Contribution to the professional component	40% understanding fundamentals of probabilistic and statistics topics 40% modelling and solving probability-related problems in civil engineering 20% mastering / utilizing numerical methods and tools to solve problems
Relationship to program objectives	***1. Provide probability and statistical skills in civil engineering design, construction and management*** This course conveys statistics and probability knowledge which can be used to address uncertainties in engineering design, construction and management. ***2. Stimulate self-learning through open-ended problems*** The course provides some basic knowledge in computer simulation and the use of computing software toolboxes, which are utilized to treat traditionally tedious problems efficiently and creatively on computers.
Relationship to program outcomes	***1. Obtain fundamental knowledge in mathematics and science*** Students learn the fundamental theories of probability and statistics, and apply them in practical scenarios involving uncertainties in civil engineering systems. ***2. Acquire an ability to apply modern engineering and IT tools***

	Students are taught to use state-of-the-art computing software toolboxes such as Python to automate tedious tasks such as matrix algebra, nonlinear equations involving statistical tables, and hypothesis testing. ***3. Develop an ability to identify and formulate civil engineering problems and propose feasible solutions*** Students are frequently exposed to examples/scenarios with open-ended design questions, which require them to apply theories learnt to define, formulate and eventually analyze the uncertainty of civil engineering systems of concern. ***4. Develop an appreciation of the breath of civil engineering and acquire basic knowledge in several disciplines*** Students are exposed to non-deterministic problems from multiple disciplines of civil engineering, and hence made aware that uncertainty exists in all types of science and engineering scenarios.
Assessment of Outcomes	1. Assignments are given to students to facilitate learning in the subject (for outcomes 1, 2, 3, 4) 2. This course is split into two parts. A mid-term exam is held at the conclusion of each part to assess student understanding during the learning process (for outcomes 1, 2, 3) 3. *Part 1 (50%):* 1. Assignments: 18% (6% x 3) 2. Mid-term examination: 32% *Part 2 (50%):* 1. Assignments: 18% (6% x 3) 2. Mid-term examination: 32% (to be held at ARR-scheduled final exam time and venue; covers only Part 2)
Prepared by	Anthony Kwan LEUNG and Jize ZHANG
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