Form 2B

City University of Hong Kong

Information on a Course
offered by School of Energy and Environment
with effect from Semester A in 2014 / 2015

Part I

Course Title: Data Analysis in Environmental Applications

Course Code: SEE5211

Course Duration: One semester

Credit Units: 3

Level: P5

Medium of Instruction: English

Prerequisites: N/A

Precursors:
MA2158 Linear Algebra and Calculus and
MA2176 Basic Calculus and Linear Algebra

Equivalent Courses: N/A

Exclusive Courses: N/A

Part II

Course Aims
The course is designed for beginning postgraduate students in the M.Sc. in Energy and Environment. The course will provide students with knowledge in understanding and using statistical methods in environmental science and applications. Probability distributions, parametric tests of significance against non-parametric tests, Monte Carlo methods, spatial and time series data analysis, Principal Component Analysis, and correlation method etc will be taught in the course facilitated by extensive use of real world problems as example. The students will be able to apply these methods in various environmental applications and learn to interpret the data to solve environmental problems.

Course Intended Learning Outcomes (CILOs)

Upon successful completion of this course, students should be able to:

No.	CILOs	Weighting
1	Explain the concepts of basic statistical methods	10%
2	Use probability distributions, parametric, tests of significance against non-parametric tests, Monte Carlo methods to analyze environmental datasets and solve environmental problems creatively;	20%
3	Use PCA analysis, and correlation method to analyze environmental datasets and discover the linkage between the data results and with environmental problems.	50%
4	Apply these methods creatively to explain the basic physical processes in environmental science.	20%

Teaching and Learning Activities (TLAs)

(Indicative of likely activities and tasks designed to facilitate students' achievement of the CILOs. Final details will be provided to students in their first week of attendance in this course)

TLAs	Lectures	Group Discussion	Tutorials	Total no. of hours
CILO 1	2	-	1	3
CILO 2	10	2	3	15
CILO 3	12	2	4	18
CILO 4	2	-	1	3
Total (hrs)	26	4	9	39

Assessment Tasks/Activities

(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)

Examination duration: 2 hrs

Percentage of coursework, examination, etc.: 40% by coursework; 60% by exam

TLAs	Assignment (%)	Midterm (%)	Final Exam (%)	Total (%)
CILO 1	10	-	-	10
CILO 2	10	-	20	30
CILO 3	10	-	20	30
CILO 4	10	-	20	30
Total	40	-	60	100

To pass a course, a student must do ALL of the following:

1) obtain at least 30% of the total marks allocated towards coursework (combination of assignments, pop quizzes, term paper or mini project, lab reports and/ or quiz, if applicable);
2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3) meet the criteria listed in the section on Grading of Student Achievement.

Grading of Student Achievement: Refer to Grading of Courses in the Academic Regulations for Taught Postgraduate Degrees.

Grade A

The student completes all assessment tasks/activities and the work demonstrates excellent understanding of the scientific principles and the working mechanisms. He/she can thoroughly identify and explain how the principles are applied to science and technology for solving physics and engineering problems. The student's work shows strong evidence of original thinking, supported by a variety of properly documented information sources other than taught materials. He/she is able to communicate ideas effectively and persuasively via written texts and/or oral presentation.

Grade B

The student completes all assessment tasks/activities and can describe and explain the scientific principles. He/she provides a detailed evaluation of how the principles are applied to science and technology for solving physics and engineering problems. He/she demonstrates an ability to integrate taught concepts, analytical techniques and applications via clear oral and/or written communication.

Grade C

The student completes all assessment tasks/activities and can describe and explain some scientific principles. He/she provides simple but accurate evaluations of how the principles are applied to science and technology for solving physics and engineering problems. He/she can communicate ideas clearly in written texts and/or in oral presentations.

Grade D

The student completes all assessment tasks/activities but can only briefly describe some scientific principles. Only some of the analysis is appropriate to show how the principles are applied to science and technology for solving physics and engineering problems. He/she can communicate simple ideas in writing and/or orally.

Grade F

The student fails to complete all assessment tasks/activities and/or cannot accurately describe and explain the scientific principles. He/she fails to identify and explain how the principles are applied to science and technology for solving physics and engineering problems objectively or systematically. He/she is weak in communicating ideas and/or the student's work shows evidence of plagiarism.

Part III

Key syllabus:

1. Probability distributions

(1) Introduction - concepts of probability, random variables and probability distributions.
(2) Probability distributions (discrete and continuous): normal distribution, Central Limit theorem, *t*-distribution, and Fisher's F-distribution, gamma and other distributions.
(3) Application of probability distributions in environmental or related data analysis, e. g. particle size distributions, detection limit of environmental analysis.

2. Tests of hypothesis

(1) Type I error, Type II error, level of significance,
(2) One tailed tests and two tailed *t*-tests.
(3) Analysis of variance (ANOVA)
(4) Boot strap and Monte Carlo methods.
(5) Application of test of hypothesis in environmental or related data analysis, e.g. compliance of environmental standards etc.

3. Regression analysis

(1) Simple regression - estimation of regression line, analysis of variance, confidence interval for regression coefficients, and confidence band for regression line.
(2) Multiple regression - estimation of regression plane, partial correlation, and multiple correlation.
(3) Nonlinear and categorical regression
(4) Application of regression analysis in environmental or related data, e.g. calibration of environmental analysis.

4. Spatial and time series data analysis

(1) Difference of random, uniform and clustered spatial distribution;
(2) Significance tests on the various spatial distributions;
(3) Trend and seasonality analysis of time series data;
(4) High time resolution data analysis methodology for background and spike detection

5. Principal Component Analysis

(1) Introduction of Principal Components Analysis- rotated and complex empirical orthogonal functions, singular Value Decomposition, canonical Correlation Analysis.
(2) Application of PCA on complicated environmental data sets, e.g. source identification of air pollutants etc.

Recommended Reading:

Reference Book(s):
Statistics for Environmental Engineers, Second Edition
Publisher: CRC Press; 2 edition (January 29, 2002)
ISBN-13: 978-1566705929