City University of Hong Kong
Course Syllabus

offered by School of Energy and Environment
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	**Data Analysis in Environmental Applications**
Course Code:	**SEE5211**
Course Duration:	**One Semester**
Credit Units:	**3 credits**
Level:	**P5**
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**Nil**
Precursors: *(Course Code and Title)*	**Nil**
Equivalent Courses: *(Course Code and Title)*	**SEE8212 Data Analysis in Environmental Applications**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. Abstract

The course will provide students with knowledge in using statistical methods in environmental science. These analysis methods such as probability distributions, parametric, tests of significance against non-parametric tests, regression analysis and variance analysis etc. are very helpful for students to understand the physical processes occurring in the environment, and to work on climate prediction.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Understand the concepts of basic statistical methods	20%	✓		✓
2.	Use probability distributions, parametric, tests of significance against non-parametric tests, regression analysis and variance analysis methods to describe environmental datasets and solve environmental problems creatively	30%		✓	✓
3.	Use correlation method to analyze environmental datasets and discover the linkage between the data results and with environmental problems	35%		✓	✓
4.	Apply these methods creatively to explain the basic physical processes in environmental science	15%	✓	✓	✓
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Explain numerical method of describing environmental data.	✓	✓	✓	✓	
Tutorials	Apply theories and concepts on practical examples	✓	✓	✓	✓	
Hands-on experiment	Require students to use statistical method to describe the characteristic of air pollutant concentration or other environmental datasets		✓	✓	✓	

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: 60%						
In-class Quizzes	✓	✓	✓	✓	20%	
Hands-on experiment		✓	✓	✓	20%	
Mid-term exam	✓	✓	✓	✓	20%	
Examination: 40% (duration: 2 hrs , if applicable)						
					100%	

Percentage of coursework, examination, etc.:
60% by coursework (assignments, mid-term exam, term paper);
40% by final exam

Notes: Each student are required to pick up one energy or environmental related problem (such as air pollutant concentration, weather data, power data, or others) to analyse the data by statistical method and computational tool (i.e. Python programming). They need to write a program and submit a report to present their findings, outcomes and conclusion. Their personal recommendation to address the problem is also needed.

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, 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 Assessment Rubrics.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. In-Class Quizzes	Ability to use the statistical concepts and knowledge to analyse and solve the energy and environmental related application problems	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Mid-term	Ability to use the statistical concepts and knowledge to analyse and solve the energy and environmental related application problems	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Hands-on experiment	Capacity for self-directed learning in exploring the energy and environmental problems, and to analyse the data using Python	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Examination	Ability to explain numerical method of describing environmental data.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. In-Class Quizzes	Ability to use the statistical concepts and knowledge to analyse and solve the energy and environmental related application problems	Excellent analysis and problem-solving skills to demonstrate in-depth understanding of probability, parameter estimation, random variable,	Good analysis and problem-solving skills to demonstrate good understanding of probability, parameter estimation, random variable, confidence	Marginally acceptable analysis and problem-solving skills to demonstrate some understanding of probability, parameter estimation, random	Poor analysis and problem-solving skills and are barely able to demonstrate an understanding of probability, parameter estimation, random

		confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.	internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.	variable, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.	variable, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.
2. Mid-term	Ability to use the statistical concepts and knowledge to analyse and solve the energy and environmental related application problems	Excellent analysis and problem-solving skills to demonstrate in-depth understanding of probability, population, distributions random variable (discrete & continuous).	Good analysis and problem-solving skills to demonstrate good understanding of probability, population, distributions random variable (discrete & continuous).	Marginally acceptable analysis and problem-solving skills to demonstrate some understanding of probability, population, distributions random variable (discrete & continuous).	Poor analysis and problem-solving skills and are barely able to demonstrate an understanding of probability, population, distributions random variable (discrete & continuous).
3. Hands-on experiment	Capacity for self-directed learning in exploring the energy and environmental problems, and to analyse the data using Python	Excellent report writing and no difficulties in identifying syntax errors. Programs conform to standard Python style and give the correct output. The energy and/or environmental problems can be solved creatively and innovatively by providing a very comprehensive	Good report writing and minor problems with syntax. Programs are structured correctly but some of the output are incorrect. The energy and/or environmental problems can be solved basically, and some recommendations are provided and discussed.	Marginally acceptable report writing and numerous problems with syntax. Programs are somewhat relevant but cannot solve the problem. Findings and recommendations are all missing.	Poor report writing and little understanding of Python syntax. Programs are unrelated to the problem.

		recommendation.			
4. Examination	Ability to explain numerical method of describing environmental data.	Excellent analysis and problem-solving skills to demonstrate in-depth understanding of probability, parameter estimation, random variable, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.	Good analysis and problem-solving skills to demonstrate good understanding of probability, parameter estimation, random variable, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.	Marginally acceptable analysis and problem-solving skills to demonstrate some understanding of probability, parameter estimation, random variable, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.	Poor analysis and problem-solving skills and are barely able to demonstrate an understanding of probability, parameter estimation, random variable, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

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 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 tests. Parametric tests of significance against non-parametric tests and Monte Carlo methods.
   (3) Application of test of hypothesis in environmental 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 regression
   (4) Application of regression analysis in environmental data, e.g. calibration of environmental analysis.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Statistics: The exploration and analysis of data, 7th Edition, 2012. Roxy Peck Jay L DeVore. ISBN-10:0840058012.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Statistics for Environmental Engineers, 2nd Edition, 2002. Linfield C. Brown, Paul Mac Berthouex, ISBN: 1566705924