

**City University of Hong Kong  
Course Syllabus**

**offered by School of Energy and Environment  
with effect from Semester A 2019/20**

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**Part I Course Overview**

<b>Course Title:</b>	<u>Data Analysis in Environmental Applications</u>
<b>Course Code:</b>	<u>SEE8212</u>
<b>Course Duration:</b>	<u>1 semester</u>
<b>Credit Units:</b>	<u>3</u>
<b>Level:</b>	<u>R8</u>
<b>Medium of Instruction:</b>	<u>English</u>
<b>Medium of Assessment:</b>	<u>English</u>
<b>Prerequisites:</b> <i>(Course Code and Title)</i>	<u>Nil</u>
<b>Precursors:</b> <i>(Course Code and Title)</i>	<u>Nil</u>
<b>Equivalent Courses:</b> <i>(Course Code and Title)</i>	<u>Nil</u>
<b>Exclusive Courses:</b> <i>(Course Code and Title)</i>	<u>Nil</u>

## 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)

No.	CILOs	Weighting	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 self-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. Teaching and Learning Activities (TLAs)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Explain numerical method of describing environmental data.	✓	✓	✓	✓	
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)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: 50 %						
Assignment	✓	✓	✓	✓	20%	
Hands-on experiment	✓	✓	✓	✓	10%	
Mid-term exam	✓			✓	20%	
Examination: 50% (duration: 2hrs , if applicable)						
					100%	

Examination duration: 2 hrs

Percentage of coursework, examination, etc.:

50% by coursework (assignments, mid-term exam, term paper);

50% by final exam

Notes: Each student will conduct a term paper on a topic of your choice. You will select one type of datasets (such as Air pollutant concentration, weather data, Power data, or others). Please prepare a *term paper* (SEE5211 Students: 1500 words + 2 figures; SEE8212 students:3000 words, 4 figures) *about data analysis*, each project should first introduce the environmental datasets or historical events and discuss the types of datasets, especially focus on collecting, analyzing, and drawing conclusions from data.

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 Grading of Student Achievement.

## 5. Assessment Rubrics

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Adequate (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	Ability to explain in detail and with accuracy method	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hands-on experiment	Capacity for self-directed learning to understand the variations of air pollutant concentration	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Field trip report	Ability to explain the methodology and procedure	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

## Part III Other Information

### 1. Keyword 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 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.
4. Time series
  - (1) Introduction- definitions of stochastic processes: purely random process, stationary process, auto-regressive process and non-stationary process.
5. Principal Component Analysis (SEE8212)
  - (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.

### 2. Reading List

#### 2.1 Compulsory Readings

1.	Statistics: The exploration and analysis of data, 7 <sup>th</sup> Edition, 2012. Roxy Peck Jay L DeVore. ISBN-10:0840058012.
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#### 2.2 Additional Readings

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