SEE2003: INTRODUCTION TO ENERGY AND ENVIRONMENTAL DATA ANALYSIS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Introduction to Energy and Environmental Data Analysis

Subject Code
SEE - School of Energy and Environment
Course Number
2003

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA1200 Calculus and Basic Linear Algebra I or
MA1300 Enhanced Calculus and Linear Algebra I; AND
MA1201 Calculus and Basic Linear Algebra II or
MA1301 Enhanced Calculus and Linear Algebra II

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The course will provide students with the knowledge of using statistical methods in energy and environmental science. Analysis methods, such as probability, random variable (discrete & continuous), parameter estimation, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test, are very helpful for students to understand the physical processes occurring in the environment, and to work on climate prediction. Students are required to use the knowledge learnt from this course to analyse the data with computational tools, such as Python. Overall, students would gain the understanding of statistical methods in energy and environmental science and they would be capable to analyse the data using statistical methods.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the concepts of basic statistical methods	20	x		x
2	Use probability, random variable (discrete & continuous), parameter estimation, confidence internal and hypothesis testing, inferences involving one and two populations, simple linear regression, analysis of variance and goodness-of-fit test to describe energy and environmental datasets and solve energy and environmental problems creatively	30		x	x
3	Use correlation method to analyse energy and environmental datasets and discover the linkage between the data results and with energy and environmental problems	35		x	x
4	Apply the statistical methods creatively to explain the problems in energy and environmental science	15	x	x	x

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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Deliver basic knowledge of statistical methods and explain numerical method of describing energy and environmental data	1, 2, 3, 4	22 (for the whole semester)
2	Tutorials	Apply theories and concepts on practical examples	1, 2, 3, 4	8 (for the whole semester)
3	Project	Require students to study a real energy and environmental problem by means of analysing data using statistics method (i.e. Python programming)	2, 3, 4	9 (for the whole semester)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments There will be several assignments throughout the semester. Students will complete the assignments to demonstrate their ability to apply their knowledge in statistics/probability to solve energy and environmental related problems.	1, 2, 3, 4	15	
2	Mid-term	1, 2, 3, 4	25	
3	Project Students are required to pick up one energy or environmental related problem 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.	2, 3, 4	25	

Continuous Assessment (%)

65

Examination (%)

35

Examination Duration (Hours)

2

Additional Information for ATs

Final exam will test students' ability to apply their knowledge learned throughout the course in energy and environmental problems.

Examination duration: 2 hrs
Percentage of coursework, examination, etc.: 65% by coursework; 35% by exam

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.

Assessment Rubrics (AR)

Assessment Task

1. Assignments

Criterion

Ability to use the statistical concepts and knowledge to analyse and solve the energy and environmental related application problems

Excellent (A+, A, A-)

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 (B+, B, B-)

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.

Fair (C+, C, C-)

Acceptable analysis and problem-solving skills to demonstrate adequate 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.

Marginal (D)

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.

Failure (F)

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.

Assessment Task

2. Mid-term

Criterion

Ability to use the statistical concepts and knowledge to analyse and solve the energy and environmental related application problems

Excellent (A+, A, A-)

Excellent analysis and problem-solving skills to demonstrate in-depth understanding of probability, population, distributions random variable (discrete & continuous).

Good (B+, B, B-)

Good analysis and problem-solving skills to demonstrate good understanding of probability, population, distributions random variable (discrete & continuous).

Fair (C+, C, C-)

Acceptable analysis and problem-solving skills to demonstrate adequate understanding of probability, population, distributions random variable (discrete & continuous).

Marginal (D)

Marginally acceptable analysis and problem-solving skills to demonstrate some understanding of probability, population, distributions random variable (discrete & continuous).

Failure (F)

Poor analysis and problem-solving skills and are barely able to demonstrate an understanding of probability, population, distributions random variable (discrete & continuous).

Assessment Task

3. Project

Criterion

Capacity for self-directed learning in exploring the energy and environmental problems, and to analyse the data using Python

Excellent (A+, A, A-)

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 recommendation.

Good (B+, B, B-)

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.

Fair (C+, C, C-)

Acceptable report writing and moderate problems with syntax. Programs are structured incorrectly and the output are largely incorrect. The energy and/or environmental problems can be solved fairly, but the recommendations are missing.

Marginal (D)

Marginally acceptable report writing and numerous problems with syntax. Programs are somewhat relevant but cannot solve the problem. Findings and recommendations are all missing.

Failure (F)

Poor report writing and little understanding of Python syntax. Programs are unrelated to the problem.

Assessment Task

4. Examination

Criterion

Ability to use the statistical concepts and knowledge to analyse and solve the energy and environmental related application problems

Excellent (A+, A, A-)

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 (B+, B, B-)

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.

Fair (C+, C, C-)

Acceptable analysis and problem-solving skills to demonstrate adequate 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.

Marginal (D)

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.

Failure (F)

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

Keyword Syllabus

- The role of statistics and the data analysis process
- Numerical method of describing data
- Probability
- Population distributions
- Random variable (discrete & continuous)
- Hypothesis testing and confidence interval
- Inferences involving one population (e.g. t-distribution, chi-square distribution, etc.)
- Inferences involving two populations (e.g. comparison of two populations, f-distribution)
- Simple linear regression
- Analysis of variance
- Goodness-of-fit test

Reading List

Compulsory Readings

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

Additional Readings

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