SYE8105: QUANTITATIVE METHODS FOR SYSTEMS ENGINEERING AND ENGINEERING MANAGEMENT

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Quantitative Methods for Systems Engineering and Engineering Management

Subject Code
SYE - Systems Engineering
Course Number
8105

Academic Unit
Systems Engineering (SYE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
SEEM8105 Quantitative Methods for Systems Engineering and Engineering Management (offered until 2021/22) /ADSE8105 Quantitative Methods for Systems Engineering and Engineering Management (offered until 2023/24)

Exclusive Courses
Nil

Part II Course Details

Abstract

This course has two parts. The first part provides students with a solid foundation of statistical concepts, theory, and methods including probability theory, statistical estimation and inference methods, and multivariate statistics and linear models. Emphasis will be placed on intuitive and rigorous understanding of the fundamentals of statistics but implementation of the statistical methods via computer programming in R or Matlab will be an important part of the course as well. The second part teaches students to simulate real-world systems and analyse the simulation model. In particular, this part will cover some basic introduction of simulation and some statistical aspects of simulation such as input analysis, random variate generation, output analysis, and variance reduction techniques.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Define the various fundamental concepts and principles in statistics.	30	x	x	
2	Derive statistical inference formulas and procedures from given assumptions.	20	x	x	
3	Establish simulation models for real-world problem	20		x	x
4	Perform statistical analysis for the simulation inputs and outputs.	30	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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Large Class Activities	Learning through teaching is primarily based on lectures. Mini-lectures and tutorials will be used to facilitate understanding and applications of various concepts and methods.	1, 2, 3, 4	26 hrs/ semester

2	Tutorial Exercises	The homework exercises provide students with the opportunities to familiarize themselves with the methods learnt during the lectures.	1, 2, 3, 4	21 hrs/ semester

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Midterm exam	1, 2, 3, 4	25	-	No
2	Assignments	1, 2, 3, 4	50	-	No

Continuous Assessment (%)

75

Examination (%)

25

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Students' ability to apply relevant statistical procedures, draw informed conclusions in data analysis, construct simulation models and perform statistical analysis.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Midterm exam (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Midterm exam focuses on the part of statistics. It assesses students' understanding of the concepts, theory, and methods of statistical inference.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Final exam (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Final exam focuses on the part of simulation. It assesses students' ability to analyze simulation models.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Students' ability to apply relevant statistical procedures, draw informed conclusions in data analysis, construct simulation models and perform statistical analysis.

Excellent

(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

Assessment Task
Midterm exam (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Midterm exam focuses on the part of statistics. It assesses students' understanding of the concepts, theory, and methods of statistical inference.

Excellent
(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

Assessment Task
Final exam (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Final exam focuses on the part of simulation. It assesses students' ability to analyze simulation models.

Excellent
(A+, A, A-) Excellent

Good
(B+, B) Good

Marginal
(B-, C+, C) Marginal

Failure
(F) Failure

Part III Other Information

Keyword Syllabus

- Probability theory and distributions (probability space, random variables, expectation and convergence of random variables)
- Statistical inference concepts (maximum likelihood, statistical decision theory, Bayesian inference, bootstrap)
- Multivariate statistics and linear model theory
- Construction of simulation models
- Input analysis, random variate generation
- Output analysis, and variance reduction techniques

Reading List

Compulsory Readings

	Title
1	Wasserman, L. (2013). All of statistics: a concise course in statistical inference. Springer Science & Business Media.

Additional Readings

	Title
1	Khuri, A. I. (2003). Advanced calculus with applications in statistics (Vol. 486). John Wiley & Sons.
2	Rosenthal, J. S. (2006). A first look at rigorous probability theory. World Scientific Publishing Co Inc.
3	Blitzstein, J. K., & Hwang, J. (2014). Introduction to probability. CRC Press.
4	Martinez, W. L., & Martinez, A. R. (2007). Computational statistics handbook with MATLAB (Vol. 22). CRC press.
5	Manuel D. Rossetti. (2015). Simulation Modeling and Arena, 2nd Edition. Wiley.