BIOS8004: ADVANCED STATISTICAL THEORY

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Advanced Statistical Theory

Subject Code
BIOS - Biostatistics
Course Number
8004

Academic Unit
Biostatistics (BIOS)

College/School
College of Computing (CC)

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
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
The course aims to provide students with some theoretical background and mathematical tools in theoretical statistics to access the literature on biostatistics methodologies and applications. Topics covered include: efficiency of estimators;

efficiency of tests; empirical processes; functional delta method; quantile and order statistics; L-statistics; bootstrap; high-dimensional models, gradient descent optimization. Selected topics such as empirical likelihood, U-statistics, counting process methods in survival analysis, functional data analysis, nonparametric estimation, shape-constrained inference, and semiparametric inference and efficiency will also be included.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the fundamental concepts in statistical estimation and inference	20	x	x	
2	Be familiar with empirical process and resampling techniques	20	x	x	
3	Acquire the techniques of evaluating the efficiency for various estimation and testing procedures	20	x	x	x
4	Ability to apply the skills and techniques to solve real problems in health-related studies	20	x	x	x
5	Effectively summarize and present research results from the literature	20	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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Learning through teaching is primarily based on lectures	1, 2, 3, 4, 5	3 hours/week
2	Assignments	Learning though take-home assignments helps students understand the key concepts and acquire the techniques	1, 2, 3, 4, 5	After class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3	30	Help to train students with basic knowledge, concepts, and analysis techniques	Yes
2	Midterm/quizzes/ presentation	1, 2, 3, 4, 5	30	Test students' capabilities in applying the knowledge to solve relevant problems	No

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

3

Minimum Continuous Assessment Passing Requirement (%)

40

Minimum Examination Passing Requirement (%)

35

Additional Information for ATs

Examination questions are designed to see how well students have achieved the learning objectives and acquired the requisite techniques for problem-solving.

To pass the course, students are required to obtain a minimum of 40% in continuous assessment and a minimum of 35% in the examination.

Assessment Rubrics (AR)

Assessment Task

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

Criterion

Problem solving skills

Excellent

(A+, A, A-) Consistently exhibits adept comprehension of statistical estimation and inference and their practical implementation

Good

(B+, B, B-) Sufficiently applies comprehension of statistical estimation and inference to moderately complex problems

Fair

(C+, C, C-) Demonstrates a moderate understanding of comprehension of statistical estimation and inference and their practical application to intermediate-level problems.

Marginal

(D) Displays basic grasp of statistical estimation and inference and their application to straightforward problems.

Failure

(F) Shows limited comprehension of statistical estimation and inference and lacks the ability to apply them to problem-solving

---

Assessment Task

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

Criterion

Problem solving based on comprehensive understanding

Excellent

(A+, A, A-) Exhibits a thorough grasp of statistical estimation and inference and effectively applies them to intricate problems

Good

(B+, B, B-) Displays sufficient understanding of statistical estimation and inference and effectively applies them to moderately complex problems

Fair

(C+, C, C-) Exhibits a moderate level of statistical estimation and inference and effectively applies them to intermediate-level problems.

Marginal

(D) Shows basic comprehension of statistical estimation and inference and applies them to straightforward problems

Failure

(F) Displays limited grasp of statistical estimation and inference and lacks the ability to apply them to problem-solving

---

Assessment Task

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

Criterion

Problem solving based on comprehensive understanding

Excellent

(A+, A, A-) Consistently exhibits a deep understanding of statistical estimation and inference and effectively applies them to complex problems

Good

(B+, B, B-) Effectively applies statistical estimation and inference concepts to moderately complex problems, demonstrating sufficient understanding

Fair

(C+, C, C-) Applies statistical estimation and inference concepts to intermediate-level problems with a moderate level of understanding.

Marginal

(D) Applies statistical estimation and inference to simple problems with a basic understanding

Failure

(F) Lacks understanding of statistical estimation and inference and cannot apply them to problem-solving

---

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

Criterion
Problem solving skills

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

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

Criterion
Problem solving based on comprehensive understanding

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Not even reaching marginal levels

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

Criterion
Problem solving based on comprehensive understanding

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure

(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Efficiency of estimators; efficiency of tests; empirical processes; functional delta method; quantile and order statistics; L-statistics; bootstrap; high-dimensional models, gradient descent optimization.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Asymptotic Statistics (Cambridge University Press Series in Statistical and Probabilistic Mathematics), by A. W. van der Vaart.
2	Mathematical Statistics (Springer), by Jun Shao.