SDSC3007: ADVANCED STATISTICS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Advanced Statistics

Subject Code
SDSC - Data Science
Course Number
3007

Academic Unit
Data Science (DS)

College/School
College of Computing (CC)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MS2602 Statistical Inference OR
SDSC2102 Statistical Methods and Data Analysis

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

In this course, students will learn statistical theories and methods for drawing inference from data. Fundamental statistical concepts and theories in point estimation, hypothesis testing and asymptotic inference are taught. Students will learn properties that good parameter estimates and hypothesis tests should possess, and use them as criteria in the development and justification of parameter estimators and test procedures. Some fundamental aspects of the linear model theories are also covered.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Derive sufficient statistics, maximum likelihood estimators, and likelihood ratio tests	25		x	
2	Establish limiting distribution of sample estimators and asymptotic inference results	35	x	x	
3	Justify point estimators and hypothesis test procedures with statistical decision theory.	20	x		
4	Elaborate the theory of linear models.	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	Lecture	Students will engage in lectures to conduct statistical tests and implement statistical decision theory and asymptotic inference procedures. Students will go through examples to facilitate conceptual understanding and applications of various statistical inference methods.	1, 2, 3, 4	39 hours/ semester

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Midterm Exam	1, 2	25	Students will participate in a 2-hour midterm exam to demonstrate conceptual understanding of statistical inference theory and methods.	No
2	Assignments	1, 2, 3, 4	25	Students will demonstrate their abilities to employ correct statistical inference methods, justify the methods using appropriate theory and correctly explain and present results with conclusions.	No

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

Note: To pass the course, apart from obtaining a minimum of 40% in the overall mark, a student must also obtain a minimum mark of 30% in both continuous assessment and examination components.

Assessment Rubrics (AR)

Assessment Task

Midterm Exam

Criterion

Abilities to show conceptual understanding of statistical inference theory and to implement correct statistical methods

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

Criterion
Abilities to employ correct statistical inference methods and to justify the methods using appropriate theory, correct explanation and presentation of results.

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
Examination

Criterion
Abilities to show levels of achievement of the intended learning outcomes, with emphasis on conceptual understanding and correct application, mostly through mathematical exposition, clear explanation, and numerical calculation of various statistical inference techniques.

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

Part III Other Information

Keyword Syllabus

Review of probability and distribution; exponential class of distributions
Review of elementary statistical inferences
Consistency and limiting distributions, law of large numbers, central limit theorem, Slutsky theorem, Delta methods
Likelihood inference, sufficiency, completeness, Cramer-Rao inequality, Fisher information, sampling theory, asymptotic efficiency
Optimal tests of hypothesis, likelihood ratio test, Bayesian procedures
Linear model theory, best linear unbiased estimator, Gauss-Markov theorem, sampling theory

Reading List

Compulsory Readings

	Title
1	Introduction to Mathematical Statistics – Hogg, McKean & Craig (7/e, Pearson, 2012)

Additional Readings

	Title
1	Nil