

SDSC3007: ADVANCED STATISTICS

Effective Term

Semester A 2024/25

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 (e.g. Parameter for GenAI use)
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.
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.

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

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