SDSC3105: BAYESIAN ANALYSIS

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Bayesian Analysis

Subject Code
SDSC - School of Data Science
Course Number
3105

Academic Unit
School of Data Science (DS)

College/School
School of Data Science (DS)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2506 Probability and Statistics or MA2510 Probability and Statistics

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims at offering students rigorous knowledge of Bayesian statistical theory and methods, developing students' abilities of interpreting and communicating results, as well as training students to apply software packages such as R or Matlab to fit Bayesian models and conduct Bayesian analyses.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand basic concepts and theory of Bayesian statistics	30	x		
2	Apply Bayes theorem to derive the posterior distribution of statistical model parameters, and various approximation methods to approximate the posterior distribution	30	x	x	
3	Apply numerical methods (e.g. numerical integration, Monte Carlo simulation) to perform Bayesian inference with the help of software packages	25	x	x	
4	Implement Bayesian methods to analyse data	15	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	Lectures	Lectures	1, 2, 3, 4	3 hours/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3, 4	30	
2	Test	1, 2, 3, 4	30	

Continuous Assessment (%)

60

Examination (%)

40

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
Coursework

Criterion
Assignments and/or participation

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
Test

Criterion
Midterm test to assess students' understanding of Bayesian statistics.

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

2-hour examination to assess students' understanding of Bayesian statistics. Examination questions are designed to assess student's level of achievement of the intended learning outcomes, with emphasis placed on understanding and correct application, mostly through mathematical exposition, clear explanation, and numerical calculation, of the various aspects of Bayesian statistics.

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

Additional Information for AR

Examination, test, and assignments, will be numerically-marked.

Part III Other Information

Keyword Syllabus

Bayes theorem and decision theory
Bayes theorem, prior distribution, posterior distribution
Bayes risk
Types of prior distributions
Conjugate priors, noninformative priors
Some basic Bayesian models
Inference for discrete parameters
Inference for binomial proportion and Poisson mean
Inference for normal mean and variance
Conjugate Bayesian models
Bayesian linear models
Simple linear regression
Multiple linear regression
Bayesian computation
Normal approximation
Numerical integration
Monte Carlo simulation

Reading List

Compulsory Readings

	Title
1	Bolstad, W. M., & Curran, J. M. (2017). Introduction to Bayesian statistics (3rd Edition). New Jersey: John Wiley & Sons.

2	Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2014). Bayesian data analysis (3rd Edition). Boca Raton: CRC press.

Additional Readings

	Title
1	Kruschke, J. K. (2014). Doing Bayesian data analysis: A tutorial with R, JAGS and Stan. Burlington: Academic Press.
2	Press, S. J. (2003). Subjective and objective Bayesian statistics: principles, models, and applications (2nd Edition) . New Jersey: John Wiley & Sons.