DSC6003: BAYESIAN DATA ANALYSIS

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Bayesian Data Analysis

Subject Code
DSC - Data Science
Course Number
6003

Academic Unit
Data Science (DS)

College/School
College of Computing (CC)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
SDSC6003 Bayesian Data Analysis

Exclusive Courses
Nil

Part II Course Details

Abstract
The aim of this course is to provide students with an introduction to Bayesian statistics and to build students' ability to develop Bayesian models for practical data analysis problems. Students will learn to implement Bayesian models with

Markov chain Monte Carlo and other numerical methods in software (MATLAB or R) and interpret the results. In addition, they will learn about the Bayesian perspective and its underlying theory.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Define Bayes theorem and concepts in Bayesian statistics.	10	x		
2	Apply Bayes theorem to derive the posterior distribution of statistical model parameters.	30	x	x	
3	Apply Markov chain Monte Carlo and other numerical algorithms in MATLAB or R to compute the posterior distribution of statistical model parameters.	30	x	x	
4	Explain Bayesian decision theory, types of prior distribution, and Bayesian model selection and averaging.	10	x	x	
5	Implement Bayesian methods to analyse a real dataset.	20		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	Students will engage in formal lectures to gain knowledge about the theory and methods of Bayesian statistics.	1, 2, 3, 4, 5	26 hours/sem
2	Demonstration of computer codes	Students will develop an understanding of the computer codes included in the course materials by following an in-class demonstration and explanation of the codes.	2, 3, 4, 5	13 hours/sem

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Midterm exam	1, 2, 3, 4, 5	25	-	No
2	Assignments	1, 2, 3, 4, 5	30	-	No

Continuous Assessment (%)
55

Examination (%)
45

Examination Duration (Hours)
2.5

Minimum Examination Passing Requirement (%)
30

Assessment Rubrics (AR)

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

Criterion
Midterm exam to assess students' level of achievement of CILOs 1-5 on material covered before the midterm exam.

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 before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Assignments are designed to assess student's level of achievement of CILOs 1-5, particularly CILOs 2-5.

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

Criterion
Examination questions are designed to assess student's level of achievement of CILOs 1-5 on all material covered, with emphasis placed on correct application, mostly through precise mathematical exposition, clear explanation, and accurate 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

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

Criterion
Midterm exam to assess students' level of achievement of CILOs 1-5 on material covered before the midterm exam.

Excellent
(A+, A, A-) High

Good
(B+, B) Moderate

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

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

Criterion

Assignments are designed to assess student's level of achievement of CILOs 1-5, particularly CILOs 2-5.

Excellent

(A+, A, A-) High

Good

(B+, B) Moderate

Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

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

Criterion

Examination questions are designed to assess student's level of achievement of CILOs 1-5 on all material covered, with emphasis placed on correct application, mostly through precise mathematical exposition, clear explanation, and accurate numerical calculation, of the various aspects of Bayesian statistics.

Excellent

(A+, A, A-) High

Good

(B+, B) Moderate

Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Additional Information for AR

The test, assignments, and examination will be numerically-marked, and grades-awarded accordingly.

Part III Other Information

Keyword Syllabus

- Bayes theorem, prior distribution, posterior distribution
- Conjugate priors
- Decision theory, loss functions, Bayes risk, Bayes estimator
- Markov chain Monte Carlo simulation, Gibbs sampling, Metropolis-Hasting algorithm
- Hierarchical models, hierarchical linear models
- Bayesian model selection and model averaging

Reading List

Compulsory Readings

	Title
1	Press, S. J. (2003). Subjective and objective Bayesian statistics: principles, models, and applications (2nd 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.
3	Turkman, M. A. A., Paulino, C. D., & Müller, P. (2019). Computational Bayesian Statistics: An Introduction (Vol. 11). Cambridge: Cambridge University Press.

Additional Readings

	Title
1	Kruschke, J. (2014). Doing Bayesian data analysis: A tutorial with R, JAGS, and Stan. Academic Press.
2	Koch, K. R. (2007). Introduction to Bayesian statistics. Springer Science & Business Media.