City University of Hong Kong
Course Syllabus

offered by School of Data Science
with effect from Semester A 2021/22

Part I Course Overview

Course Title:	**Bayesian Analysis**
Course Code:	**SDSC3105**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**B3**
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**MA2506 Probability and Statistics**
Precursors: *(Course Code and Title)*	**Nil**
Equivalent Courses: *(Course Code and Title)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. Abstract

(A 150-word description about the course)

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.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	**Understand** basic concepts and theory of Bayesian statistics	30%	√		
2.	**Apply** Bayes theorem to derive the posterior distribution of statistical model parameters, and various approximation methods to approximate the posterior distribution	30%	√	√	
3.	**Apply** numerical methods (e.g. numerical integration, Monte Carlo simulation) to perform Bayesian inference with the help of software packages	25%	√	√	
4.	**Implement** Bayesian methods to analyse data	15%	√	√	
	** If weighting is assigned to CILOs, they should add up to 100%.*	100%			

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lectures	Lectures	√	√	√	√	26 hours/semester
Tutorial	Numerical exercises and software usage training		√	√	√	13 hours/semester

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting*	Remarks
	1	2	3	4		
Continuous Assessment: 60%						
Assignments	√	√	√	√	30%	
Test	√	√	√	√	30%	
Examination: 40% (duration: 2 hours)						
Examination	√	√	√	√	40%	
**The weightings should add up to 100%.*					100%	

For a student to pass the course, at least 30% of the maximum mark for the examination should be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Coursework	Assignments and/or participation	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Test	Midterm test to assess students' understanding of Bayesian statistics.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	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.	High	Significant	Moderate	Basic	Not even reaching marginal levels

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

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

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

2. Reading List

2.1. Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Bolstad, W. M., & Curran, J. M. (2017). Introduction to Bayesian statistics (3rd Edition). New Jersey: John Wiley & Sons.
2.	Press, S. J. (2003). *Subjective and objective Bayesian statistics: principles, models, and applications (2nd Edition)* . New Jersey: John Wiley & Sons.
3.	

2.2. Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Kruschke, J. K. (2011). Doing Bayesian data analysis: A tutorial with R and BUGS. Burlington: Academic Press.
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.