STA 426 Bayesian Analysis

Winter 2024

Course Credits: 4
Contact Hours: 56 hours
Instructor: TBA
Email:TBA

COURSE OBJECTIVES

This course is designed to provide an introduction to fundamental conceptual, computational, and practical methods of Bayesian data analysis. We will progress by first discussing the fundamental Bayesian principle of treating all unknowns as random variables. Next, we will discuss multi-parameter problems, and large-sample asymptotic results leading to normal approximations to posterior distributions. We will continue with hierarchical models, model construction and checking, sensitivity analysis and model comparison. Conceptual understanding and inference via computer simulation will be emphasized throughout the course.

Upon Completion of this Course, students will be able to:

1. Handle the general Bayesian principles and the foundation for Bayesian analysis;
2. Perform estimation, prediction, and uncertainty quantification based on the posterior and posterior predictive distributions;
3. Assess the appropriateness of a Bayesian model and conduct model comparison and checking;
4. Apply Bayesian methodology to solve real-life problems.

PREREQUISITES

STA 415 Statistical Inference

GRADING

Grades will be determined by accumulating points, with 100 points being the

maximum, as follows:

ITEM	POINTS
2 Assignments	20 Points
2 Quizzes	20 Points
Midterm Exam	25 Points
Final Exam	35 Points
Total	100 Points

Late submissions will be graded at the end of the course. Grades will be assigned according to the following rule:

$A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F$.

We reserve the right to make adjustments to the overall grading policy.

COURSE MATERIALS

Required Texts:

Bayesian Data Analysis, Third Edition, Gelman, A., Carlin, J.B., Stern, H., Dunson, D., Vehtari, A., and Rubin, D. Chapman and Hall, 2014..

Recommended (Optional) Texts or Other Materials:

None

COURSE TOPICS

MODULE	TASKS
Module 1	**Topics:** Topic 1: Probability and inference Topic 2: Single-parameter models Topic 3: Informative prior distributions Topic 4: Introduction to multiparameter models **Assessments:** Assignment #1

Module 2	**Topics:** Topic 5: Hierarchical models Topic 6: Model checking Topic 7: Evaluating, comparing, and expanding models Topic 8: Modeling accounting for data collection **Assessments:** Quiz #1
Module 3	**Topics:** Topic 9: Bayesian decision theory in different contexts Topic 10: Introduction to Bayesian computation Topic 11: Basics of Markov chain simulation Topic 12: Computationally efficient Markov chain simulation **Assessments:** Assignment #2 Midterm Exam
Module 4	**Topics:** Topic 13: Introduction to regression models Topic 14: Hierarchical linear models Topic 15: Generalized linear models Topic 16: Models for missing data **Assessments:** Quiz #2
Module 5	**Topics:** Topic 17: Parametric nonlinear models Topic 18: Basis function models Topic 19: Gaussian process models Topic 20: Finite mixture models **Assessments:** Final Exam

ATTENDANCE

1) Class attendance is required. Missing classes without permission will lead to decrease in overall grade.

Missing less than two classes: no penalty.

Missing more than two classes: 7% will be taken off from the overall grade.

If the instructor reports a student's frequent missing of class to the Soochow University Academic Administration Office, the student might get a written warning and might be prohibited from attending final exam.

2) Participants in this course are expected to arrive in class promptly and adequately prepared. The primary objective of this course is to critically engage with the readings and the subject matter. Therefore, course participants are expected to have completed the reading prior to class and prepare thoughtful reflections/commentaries to share with fellow colleagues.

LEARNING REQUIREMENTS

1) Late assignments are not acceptable and are subjected to grade deductions.
2) Assignments submitted in the wrong format will be counted as not submitted.
3) Failure to submit or fulfill any required course component results in failure of the class.
4) Make-up for midterm and final exams only with valid excuses, as defined by the University.
5) In order to earn a Certificate of Completion, participants must thoughtfully complete all assignments by stated deadlines and earn an average quiz score of 50% or greater.

TECHNOLOGY POLICY

The use of electronic devices in class is distracting, both for the user and for the rest of the class. Only non-programmable calculators can be used in the tests and exam. Any attempts to use cell phones and other electronic communication devices will be seemed as cheating. Laptops are discouraged, unless you use them for activities DIRECTLY related to the course (eg., note taking, reading course documents).

ACEDEMIC INTEGRITY POLICY

Soochow University highly values the academic integrity and aims to promote the academic fairness, honesty and responsibility. Any academic dishonesty behaviors and any attempts to cheats and plagiarism will be reported to the university administration office. A written warning and the relevant penalties will be imposed. The record might be shown on the official university transcript.

DISABILITY ACCOMMODATION

Soochow University is committed to maintaining a barrier-free environment so that students with disabilities can fully access programs, courses, services, and activities at Soochow University. Students with disabilities who require accommodations for access to and/or participation in this course are welcome.

Note:

Please contact the University Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material.