附件 2

Bayesian data analysis: Theory and Methods

Course code: **100171316**

Course name: **Bayesian data analysis: Theory and Methods**

Lecture Hours: **48**
Laboratory Hours: **0**
Credits: **3**

Term(If necessary): 1 term, Spring semester

Prerequisite(s): Some background in calculations, linear algebra, probability, statistical inference (or mathematical statistics), and statistical computing. Prior programming experience in python or R

Course Description:

The objective of this course is to explore Bayesian statistical theories and methods. Students would learn how to formulate a scientific question by constructing a Bayesian model and performing Bayesian statistical inference to answer that question. Throughout this course, students would be exposed to the theory of Bayesian inference. They would also learn several computational techniques and use these techniques for the Bayesian analysis of real data. Additional topics may vary.

Course Outcomes:
After completing this course, a student should be able to:
1. Formulate a scientific question via Bayesian model.
2. Performing Bayesian statistical inference.
3. Understand some basic theories of Bayesian inference.
4. Learn several computational techniques

Course Content:

Lectures and Lecture Hours:

1. Basic concepts in Bayesian statistics 6
   - Probability and inference
   - Bayesian estimation and hypothesis testing
   - Asymptotics and connections to non-Bayesian approaches
2. Fundamentals of Bayesian data modeling. 12
   - Hierarchical models
   - Model checking, evaluating, and comparing

- Modeling accounting for data collection
- Linear models and Hierarchical linear models
- Generalized linear models
- Models for robust inference

3. Bayesian Computation 12
   - Monto Carlo and Quasi Monto Carlo
   - Markov chain based methods
   - Modal and distributional approximation
4. A short introduction to Bayesian decision theory and nonparametric modeling. 6
   - Basic concept for decision theory
   - Markov decision processes and dynamic programming
   - Spline and Gaussian process models
5. Bayesian data analysis in our daily life. (in-class discussion and student presentation). 12

Grading:

Homework	40%
Scribe in-class notes.	20%
Midterm proposal	5%
Group Oral Presentation	10%
Final Write-up Report	15%

Assignments are due in class. If you missed the class, contact the TA to turn in your homework by the end of the day. No late homework will be accepted. Coursework may include computer assignments.

Text & Reference Book:

Main textbook

- Gelman, A., Carlin, J., Stern, H., and Rubin, D. (2003). Bayesian Data Analysis, 3rd Edition, Chapman & Hall.

Other interesting references

- Liu, J. (2001). Monte Carlo Strategies in Scientific Computing, Springer-Verlag.
- Lange, K. (2002). Numerical Analysis for Statisticians, Springer-Verlag, 2nd Edition.
- Sutton, R. S. and Barto, A. G. (2018). Reinforcement Learning: An Introduction (2nd ed.). MIT Press.