MATH 559
BAYESIAN THEORY AND METHODS

Instructor :	David A. Stephens (Burnside 1225)
Email :	david.stephens@mcgill.ca

Texts :	*The Bayesian Choice*, CP Robert.
	Bayesian Core: A Practical Approach to Computational Bayesian Statistics, J-M Marin and CP Robert.
	Bayesian Theory, J.M. Bernardo and AFM Smith
	Monte Carlo Statistical Methods, CP Robert and G Casella.
Prerequisites :	MATH 323/356, MATH 324/357, or equivalents, or by permission of instructor.
	Good knowledge of calculation methods for probability distributions Familiarity with classical statistical methods, especially likelihood-based methods Knowledge of regression approaches useful. Experience in `R` or `python` useful.

This course provides an introduction to Bayesian inference and key Bayesian methods. Contrast will be made with the frequentist or classical approaches to statistics. Core theoretical ideas will be introduced from first principles stemming from de Finetti's representation for exchangeable random variables. Inference for standard parametric models will be introduced, and extended to hierarchical and more complex models. Simulation-based inference will be introduced, specifically computational strategies based on Monte Carlo methods. The course will contain an introduction to Markov chain Monte Carlo with implementation in `R`, `Stan` or `python`. An introduction to Bayesian nonparametric methods.

TARGET SYLLABUS

Topics to be covered include: Recap of frequentist statistical theory; subjective probability, Bayesian statistical inference and decision making; de Finetti's representation; parametric methods; optimal decisions; conjugate models; methods of prior specification and elicitation; approximation methods; hierarchical models; computational approaches to inference; Markov chain Monte Carlo methods; Metropolis–Hastings; nonparametric Bayesian inference.

METHOD OF EVALUATION

- Five assignments, best four to count ($4 \times 10 = 40$ %)

  Assignments will be a mix of theory calculations and computational work.

  Assignments will be set roughly every two weeks from the end of the Add/Drop period.

  Penalty for late submission may be up to 100%.

- Final exam (60 %)

  Final exam will be a regular final exam held during the University examination period.

  The examination timetable is set by the Examinations Office and is not in the control of the Instructor. You are advised not to make travel arrangements until the date of the final exam is confirmed.

In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change. If you need special assessment arrangements or accommodations, please contact *Student Accessibility and Achievement*

Student Accessibility and Achievement.

McGill Policy Statements

- **Language of Submission**

  In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded. This does not apply to courses in which acquiring proficiency in a language is one of the objectives.

  Conformément à la Charte des droits de l'étudiant de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté, sauf dans le cas des cours dont l'un des objets est la maîtrise d'une langue.

  Charter of Students' Rights

  Approved by Senate on 21 January 2009

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  L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires.

  Code of Student Conduct and Disciplinary Procedures

  Approved by Senate on 29 January 2003

- **Copyright**

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David A. Stephens
Department of Mathematics and Statistics
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