

PS931-15 Bayesian Approaches in Behavioural Science

20/21

Department

Psychology

Level

Taught Postgraduate Level

Module leader

Adam Sanborn

Credit value

15

Module duration

9 weeks

Assessment

100% coursework

Study location

University of Warwick main campus, Coventry

Description

Introductory description

Bayesian approaches have made important contributions to Behavioural Science, both as statistical models for empirical data, and as cognitive models of how people perform tasks. As statistical models, Bayesian methods are particularly important for establishing the absence of an effect, which is difficult for standard statistical methods to do. As cognitive models, Bayesian methods prescribe what an agent should do in a task, as such provide important benchmarks against which to compare human behaviour. In both domains, approximations play an important role: allowing the practical use of complex statistical models, and providing a route to explain deviations of human and animal behaviour from the Bayesian ideal.

Module aims

The purpose of the module is to introduce Bayesian approaches to statistics and modelling of behaviour, and the approximations that make them work in practice.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be

covered. Actual sessions held may differ.

The module will introduce Bayesian statistics and Bayesian models of behaviour. In the lectures on Bayesian statistics, topics such as mixed models, estimation vs. testing, approximation, and choosing priors will be covered. In the lectures on Bayesian models of behaviour, topics such as the evidence for and against these models, the role of approximations, evolution and animal behaviour will be covered.

Learning outcomes

By the end of the module, students should be able to:

- Apply common Bayesian statistical methods to analyse empirical data in behavioural science.
- Gain familiarity with Bayesian approaches to modelling cognition and behaviour.
- Understand the evidence against Bayesian approaches to modelling cognition and behaviour, and the extent to which approximations can account for this evidence.
- Understand the logic of Bayesian statistics and the necessity of approximation methods.

Indicative reading list

Griffiths, T. L., & Tenenbaum, J. B. (2006). Optimal predictions in everyday cognition. *Psychological Science*, 17(9), 767-773.

Kruschke, J. (2014). *Doing Bayesian data analysis: A tutorial with R, JAGS, and Stan*. Academic Press.

Lambert, B. (2018). *A student's guide to Bayesian statistics*. SAGE.

Lee, M. D., & Wagenmakers, E. J. (2014). *Bayesian cognitive modeling: A practical course*. Cambridge University Press.

Ma, W. J. (2012). Organizing probabilistic models of perception. *Trends in Cognitive Sciences*, 16(10), 511-518.

McElreath, R. (2020). *Statistical rethinking: A Bayesian course with examples in R and Stan* (2nd ed.). Taylor and Francis, CRC Press.

O'Hagan, A. (2019). Expert knowledge elicitation: subjective but scientific. *The American Statistician*, 73(sup1), 69-81.

Sanborn, A. N., & Chater, N. (2016). Bayesian brains without probabilities. *Trends in Cognitive Sciences*, 20(12), 883-893.

Sanborn, A. N., & Griffiths, T. L. (2015). Exploring the structure of mental representations by implementing computer algorithms with people. In *Cognitive Modeling in Perception and Memory: A Festschrift for Richard M. Shiffrin* (pp. 212-228). Taylor and Francis Inc.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124-1131.

Vincent, B. T. (2015). A tutorial on Bayesian models of perception. *Journal of Mathematical*

Psychology, 66, 103-114.

Zhu, J., Sanborn, A. N. and Chater, N. (2020). The Bayesian sampler: generic Bayesian inference causes incoherence in human probability judgments. *Psychological Review*.

Interdisciplinary

Incorporates elements of Psychology, Economics, Business, and Statistics

Subject specific skills

Understand the logic of Bayesian statistics and the necessity of approximation methods.
Apply common Bayesian statistical methods to analyse empirical data in behavioural science.

Transferable skills

Understand the logic of Bayesian statistics and the necessity of approximation methods.
Applying common Bayesian statistical methods to analyse empirical data generally.

Study

Study time

Type	Required
Lectures	9 sessions of 2 hours (12%)
Seminars	4 sessions of 2 hours (5%)
Private study	62 hours (41%)
Assessment	62 hours (41%)
Total	150 hours

Private study description

Reviewing of lecture materials and reading of background literature

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time
Bayesian data analysis assignment Using provided data, students will perform Bayesian data analysis and write up the results	42%	25 hours
Essay on a choice of questions about Bayesian models of cognition Students will answer one question from a set of questions on Bayesian models of cognition and behaviour	42%	25 hours
weekly MCQ	16%	12 hours

Feedback on assessment

Individual written feedback will be provided during the term for the Bayesian data analysis assignment, and individual written feedback will be provided after the term for the remaining two assessments.

Availability

Courses

This module is Core optional for:

- Year 1 of TPSS-C803 Postgraduate Taught Behavioural and Data Science

This module is Optional for:

- Year 1 of TPSS-C8P7 Postgraduate Taught Behavioural and Economic Science (Science Track)
- Year 1 of TECS-C8P8 Postgraduate Taught Behavioural and Economics Science (Economics Track)
- Year 1 of TECA-L1P6 Postgraduate Taught Economics