BAYES 20 @LUND 18

A Mini-conference on Bayesian Methods at Lund University
12th of April, 2018
Lux building, Helgonavägen 3, Lund University.
`bayesat.github.io/lund2018/bayes_at_lund_2018.html`

Program

09.10–10.00 Welcome and keynote presentation

▷ *Why not to be afraid of priors (too much)*, Paul-Christian Bürkner, University of Münster, Department of Psychology.

10.00–10.20

▷ *Bayesian 3D Priors for Brain Imaging*, Per Sidén, Lindköping university, Department of Computer and Information Science.

10.20–10.40 Coffee break

10.40–12.00 Session: Bayesian Regression Models using Stan

▷ *Introducing the brms R package*, Paul-Christian Bürkner, University of Münster, Department of Psychology.

▷ *A hands-on example of Bayesian mixed models with brms*, Andrey Anikin, Lund University, Cognitive Science.

▷ *Analyzing an experiment on involuntary attention using brms*, Antonio Schettino, Ghent University, Department of Experimental Clinical and Health Psychology.

▷ *Analyzing orientation behavior in animals using Stan*, John Kirwan, Lund University, Department of Biology.

12.00–12.45 Sandwich lunch and mingle in the foyer

12.45–13.30 Keynote presentation

▷ *I know what you ate last summer! – the virtue of Bayesian analysis in food risk assessment*, Jukka Ranta, Evira Finnish Food Safety Authority, Risk Assessment Unit.

13.30–13.50

▷ *Inference in ecology and evolution beyond generalized linear mixed models*, Reinder Radersma, Lund university, Department of Biology.

13.50–14.00 Quick break

14.00–15.00 Session: Bayesian hypothesis testing

▷ *Is there something out there?* , Ullrika Sahlin, Lund University, Centre for Environmental and Climate Research.

▷ *Bayes Factors: A 're-volution' in psychology*, Geoff Patching, Lund University, Department of Psychology.

▷ *Sequential Testing with Information Criteria and Evidence Ratios*, Ladislas Nalborczyk, Univ. Grenoble Alpes & Ghent University.

15.00–15.30 Coffee and cake

15.30–16.15 Session: Approximate Bayesian inference

▷ *What to do when exact Bayes is impossible? Some tools for approximate Bayesian inference,* Umberto Picchini, Lund University, Centre for Mathematical Sciences.

▷ *Making the most out of a single datapoint using Approximate Bayesian inference*, Denis Shepelin, Technical University of Denmark, the Novo Nordisk Foundation Center for Biosustainability.

16.15–16.30

▷ *How I introduce Bayes to beginners*, Rasmus Bååth, King Digital Entertainment, Malmö.

Keynote presentations

Why not to be afraid of priors (too much)

Paul-Christian Bürkner, University of Münster, Department of Psychology, paul.buerkner@gmail.com

The prior is a key concept in Bayesian statistics that distinguishes it from most other statistical methods. Historically, it has caused many resentments against Bayesian statistics in general and remains a controversial topic to date. In my talk, I want to explain why we should usually not be too afraid of priors. At the same time, I want to highlight situations where thinking about priors is mandatory and incredibly helpful for reliable inference.

I know what you ate last summer! – the virtue of Bayesian analysis in food risk assessment

Jukka Ranta, Evira Finnish Food Safety Authority, Risk Assessment Unit, Jukka.Ranta@evira.fi

Evaluation of microbiological and chemical food safety risks typically involves several linked models. These describe different causal processes contributing to the consumer risk and can employ several data sets. When combining evidence, Bayesian modeling is a valuable and flexible method that can be used to assess, e.g., process control options and dietary exposure.

Contributed presentations

Bayesian 3D Priors for Brain Imaging

Per Sidén, Lindköping university, Department of Computer and Information Science, per.siden@liu.se

This talk discusses the use of Bayesian priors for modeling the spatial distribution of brain activity from functional magnetic resonance imaging (fMRI). The data are naturally 4D, consisting of 3D brain images measured over time, each having hundreds of thousands of data points. The Bayesian approach is attractive because (1) it gives posterior probabilities of activation in different brain regions; (2) the amount of spatial dependence can be inferred from the data and (3) the large scale computational problem can be efficiently handled using sparse Gaussian Markov random fields (GMRF) priors.

Introducing the brms R package

Paul-Christian Bürkner, University of Münster, Department of Psychology, paul.buerkner@gmail.com

This talk with introduce the the brms package which implements Bayesian multilevel models in R using the probabilistic programming language Stan. A wide range of distributions and link functions are supported, allowing users to fit linear, robust linear, binomial, Poisson, survival, response times, ordinal, quantile, zero-inflated, hurdle, and even non-linear models all in a multilevel context. In addition, all parameters of the response distribution can be predicted in order to perform distributional regression. Prior specifications are flexible and explicitly encourage users to apply prior distributions that actually reflect their beliefs. In addition, model fit can easily be assessed and compared with posterior predictive checks and leave-one-out cross-validation.

A hands-on example of Bayesian mixed models with brms

Andrey Anikin, Lund University, Cognitive Science, andrey.anikin@lucs.lu.se

While the advantages of a Bayesian approach are increasingly acknowledged, many are discouraged by the steep learning curve and the large amount of manual coding. In this talk I demonstrate how mixed models, a staple of modern data analysis, can be easily fit and explored with just a few lines of code using brms package. Starting with a dataset from a real experiment, in which listeners judged the authenticity of emotional vocalizations (a binary outcome), I will go through model specification, diagnostics, plotting, and reporting the results.

Analyzing an experiment on involuntary attention using brms

Antonio Schettino, Ghent University, Department of Experimental Clinical and Health Psychology, antonio.schettino@ugent.be

It is difficult to suppress the urge to look at your smartphone if there is a sudden flash on the screen. But would you still look at the phone if the flash always signals wrong information? We addressed this question using a visual temporal order judgment task, in which participants had to judge which of two stimuli appeared first. Some trials were preceded by a counterproductive exogenous cue, i.e., always signaling where the second target would appear. Bayesian parameter estimation and model comparison (using the

brms package in R) revealed that the cue, despite being counterproductive, consistently attracted attention.

Analyzing orientation behavior in animals using Stan

John Kirwan, Lund University, Department of Biology, john.kirwan@biol.lu.se

A recurring challenge in behavioral studies of animal senses is the analysis of angular data, which frequently occurs from tracking orientation or direction of movement. Analysis and visualization of these data are fraught with challenges, as they can be easy to misinterpret. Within the fields of animal sensory ecology and navigation, angular data has typically been investigated by comparing treatments using a limited set of significance tests. These approaches are inflexible and neglect pooling and measures of effect size and uncertainty. To address this, I have sought to analyse angular behavioral data using models in the Stan language.

Inference in ecology and evolution beyond generalized linear mixed models

Reinder Radersma, Lund university, Department of Biology, reinder.radersma@biol.lu.se

Generalized linear mixed models (GLMMs) are commonly used in many research fields, including ecology and evolution. GLMMs and the software for analyzing them offer great flexibility in for instance the number of variables and error structure, but obviously assume linearity. The tremendous flexibility of Stan to customize the structure of models offers a great, but underused potential for investigating more complex correlational/causality patterns. Here I will showcase 3 studies on humans, birds and waterfleas, in which I have used Stan to customize model structures to answer questions in ecology and evolution for which GLMMs have limited potential.

Is there something out there?

Ullrika Sahlin, Lund University, Centre for Environmental and Climate Research, ullrika.sahlin@gmail.com

I will use this simple question to demonstrate how Bayesian analysis can be used for risk assessment under sparse information and how it allows you to incorporate judgement from one or several experts.

Bayes Factors: A 're-volution' in psychology

Geoff Patching, Lund University, Department of Psychology, geoffrey.patching@psy.lu.se

In psychology, Bayes Factors (BFs) are being increasingly reported as a complement to p-values. However, just as the mindless computation of p-values encourages a simple dichotomization of study results, the mindless computation of BFs with an overemphasis on hypothesis testing detracts from more useful approaches to interpreting study results, such as parameter estimation. BFs may serve to facilitate the transition from frequentist to Bayesian data analysis, but let us not repeat mistakes of the past. In this short talk, I shall argue that Bayesian parameter estimation is preferred with an example from a recent Master thesis.

Sequential Testing with Information Criteria and Evidence Ratios

Ladislas Nalborczyk, Univ. Grenoble Alpes & Ghent University, ladislas.nalborczyk@univ-grenoble-alpes.fr

Sequential testing refers to the process of collecting data until a predefined level of evidence is reached. Recently, Schönbrodt, Wagenmakers, Zehetleitner, & Perugini (2017) and Schönbrodt & Wagenmakers (2017) have introduced the Sequential Bayes Factors (SBF) procedure, in order to avoid the pitfalls associated with sequential testing in the NHST framework. The R package ESTER (Nalborczyk, 2017) proposes an alternative approach that uses evidence ratios based on either Akaike weights computed from AIC (e.g., Burnham & Anderson, 2004) or pseudo-BMA weights computed from the WAIC or the LOO-CV of Bayesian models (Yao, Simpson, & Gelman, 2017).

What to do when exact Bayes is impossible? Some tools for approximate Bayesian inference

Umberto Picchini, Lund University, Centre for Mathematical Sciences, umberto.picchini@gmail.com

So you have postulated a nice model and now you want to perform Bayesian inference for the model parameters. Great. The problem is the model has a non-standard likelihood function.. In other words your model is sufficiently complex that you can't write the likelihood function and therefore cannot

perform full-fledged Bayesian analysis. This situation is actually the norm when working with realistic models. However there are strategies to deal with so-called "intractable likelihoods" using "likelihood-free inference". The most important examples of these methods are "approximate Bayesian computation" (ABC) and "synthetic likelihoods". I will give an introduction to both methods.

Making the most out of a single datapoint using Approximate Bayesian inference

Denis Shepelin, Technical University of Denmark, the Novo Nordisk Foundation Center for Biosustainability, denshe@biosustain.dtu.dk

Bayesian inference is based on evaluation of posterior distribution via likelihood function. However even for the simplest models sometimes there is no way for defining likelihood function in analytical way. In such situations, we still can perform Bayesian reasoning via Approximate Bayesian Computation techniques. In my talk, I want to provide an overview on typical ways to perform ABC and corresponding software packages. To demonstrate flexibility of this method I would like to present my use case on performing ABC on very complex simulator based model with 1 data point while still achieving useful results.

How I introduce Bayes to beginners

Rasmus Bååth, King Digital Entertainment, rasmus.baath@gmail.com

Bayesian statistics is a rich, deep topic, but you have to start somewhere. And there are many places to start, and many ways educators introduce Bayesian statistics: From probability as personal belief to just focussing on Markov chain Monte Carlo. In this short talk I'll give a demonstration of what I think is one good way of introducing Bayes to beginners.

Acknowledgement

The organizing committee of this year's Bayes@Lund consisted of Rasmus Bååth (King Digital Entertainment, Malmö) and Ullrika Sahlin (Centre of Environmental and Climate Research, Lund University).

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