Bayes@Lund 2019

Tuesday, 7 May 2019 - Tuesday, 7 May 2019

Palaestra, Lund University, Sweden

Programme

Tuesday 07 May 2019

Bayes@Lund 2019 registration (08:30-09:00)

Welcome (09:00-09:05)

- Presenter: HOLMES, Alexander

Bayes@Lund 2019: Keynote (09:05-09:55)

time	[id] title
09:05	**[23] Hierarchical models and their applications in astronomy** *Presenter: LIEU, Maggie* Maggie is an astrophysics research fellow working at the European Space Agency in Madrid. Her main research involves modelling the mass distribution of clusters of galaxies to understand the nature of dark matter and dark energy in our Universe. Maggie will be talking about how hierarchical models can be a powerful tool for inference.

Break (09:55-10:00)

Bayes@Lund 2019: Introducing Bayes for learning (10:00-10:40)

time	[id] title
10:00	**[4] What cause successful learning in Bayesian methods?** *Presenter: MOROZ, George* I would like to share the comparison of three groups of students that I taught Bayesian methods this year: - mixed group (psychology, biology...) with good background in R and frequentist statistics; - linguistic group (3d year) with medium background in R and frequentist statistics; - further education group in Computer Linguistic with beginner R and no statistical background. I expected first and second groups to be more successful than the third one, but the shocking result was that the third and the first groups were more successful than the second one. I will try to explain the obtained result.
10:20	**[20] Introducing Bayesian Stats through Signal Detection Theory** *Presenter: PFUHL, Gerit* To avoid starting with a formula a detour via utilized Signal detection theory (uSDT) familiarizes psychology undergraduates with some of the basic concepts in Bayesian statistics. uSDT includes payoffs (utility functions), base rates, and varies similarities, illustrated on perceptual decision processes. Payoffs and base rates influences bias, assisting students in understanding models and priors in Bayesian statistics.

Coffee break (10:40-11:00)

Bayes@Lund 2019: Bayesian inference – a tale of high flexibility (11:00-12:00)

time	[id] title
11:00	**[19] Prior thoughts on mixed-membership models in linguistics** *Presenter: CATHCART, Chundra* Bayesian mixed-membership models are popular in linguistics, as they explicitly model contact between languages (Reesink et al 2009, Syrjänen et al 2016). Most linguistic applications use the biological Structure program (Pritchard et al 2000) with default presets, fixing the concentration parameter of the population-level Dirichlet prior over allele frequency (treated as an analog for the language-level prior over features) at 1. We show, using a crosslinguistic typological database, that there are linguistically meaningful consequences for the choice of this hyperparameter (either fixed at different values, or inferred from the data) using a series of posterior predictive checks designed for mixed-membership models (Mimno et al 2015).

11:20	**[6] A Bayesian method to localize lost gamma sources** *Presenter: BUKARTAS, Antanas* Radioactive sources can sometimes be lost or misplaced despite the existing rigorous safety rules. Lost sources must be found as soon as possible to avoid inflicting harm to the public. Regardless of the type of equipment used it is desirable to use as much information as possible from the measurements to draw conclusions about the activity and location of a detected source. Using Bayesian inference it is possible to obtain a probability distribution for the position and activity of an unshielded gamma source in one pass with a mobile gamma spectrometry vehicle. The aim of this research was to investigate the feasibility of a Bayesian algorithm for mobile gamma spectrometry,test its accuracy in determining the location and activity.
11:40	**[13] Spatio-Temporal Reconstructions of Global CO2-Fluxes using Gaussian Markov Random Fields** *Presenter: DAHLÉN, Unn* Atmosperic invere modelling is a method for constraining Earth surface fluxes (sinks and sources) of green house gases using measurements of athmosperic concentrations. The (linear) link between atmospheric concentration and fluxes are provided by an atmospheric transport model. Since the number of unknown surfaces fluxes is much larger than the number of observed atmospheric concentrations, the inverse problem is ill-conditioned. Requiring further assumption on the fluxes, leading to a Bayesian model. Hitorically, fluxes are discretized to a grid and modelled by a multivariate Gaussian distribution. Instead, we define the flux on a continuous spatial domain, with fluxes modelled as Gaussian Markov Random Fields, including both spatial and temporal dependence.

Lunch & Mingle (12:00-12:45)

Bayes@Lund 2019: Keynote & contributed talk (12:45-13:50)

time	[id] title
12:45	**[25] Visualisation for refining and communicating Bayesian analyses** *Presenter: GRANT, Robert* Robert Grant is a medical statistician, turned freelance trainer, coach and writer in Bayesian models and data visualisation. His book Data Visualisation: charts maps and interactive graphics is published by CRC Press. His talk Visualisation for refining and communicating Bayesian analyses will review relevant general principles of effective visualisation, recent work on Bayesian workflow, and the role of interactive graphics.
13:30	**[14] Bayesian vs. Frequentism for experimentalists** *Presenter: LAVRÖD, Jakob* A common rebuttal to Bayesian methods is that they are appropriate for large and complex problems (containing prior information and hidden variables), and most undergraduate teaching is often based upon frequentist methods. Starting from the context of the practical experimentalist, we explore the difference between the Bayesian and Frequentist methodology and highlights the advantages of teaching the Bayesian perspective already from the start. Many of the examples and the material come from the introductory course given for the students enrolled in the high school giftedness program “International Young Physicists’ Tournament”, an attempt at introducing Bayesian thinking into experimental practice.

Break (13:50-14:00)

Bayes@Lund 2019: Bayesian decisions (14:00-15:00)

time	[id] title
14:00	**[8] Extending Bayes to Make Optimal Decisions** *Presenter: LINDELØV, Jonas Kristoffer* Utility Theory allow you to make optimal decisions in the face of uncertainty. For example, what bidding price would maximize your earnings, taking the chance of failure into account? Utility Theory latches nicely onto Bayesian Inference. Once you have a posterior distribution, you need only a few more lines of code to apply a utility function (aka loss function) and identify the decision that optimizes said utility. This approach scales well to more complex models and decisions. We will use R and rstanarm/brms for Bayesian inference and hand-code the utility. An R notebook with worked examples will accompany the tutorial.

14:20	**[5] Rich-man's Monte Carlo: Uncertainty Analysis in Excel** *Presenter: PEREPOLKIN, Dmytro* Adoption of Uncertainty Analysis in modern business environment is often challenging due to gaps in relevant skills and tooling (especially among decision makers). At the same time Excel is ubiquitous and can be used to build decision maker's intuition about uncertainties. This talk will introduce typical business problem faced by businesses and organizations on daily basis and showcase a fully transparent formula-only Excel model with no dependency on external libraries or macros, that can enlighten and inform about effect of uncertainties on business outcome(s). In this talk we will discuss framing, expert knowledge elicitation, modeling, visualization and communication of results to facilitate discussion about uncertainties and ultimately aid the decision making.
14:40	**[9] Probabilistic Programming for Voucher Information Extraction** *Presenter: AL-SIBAHI, Ahmad Salim* Probabilistic programming is a new paradigm that augments existing programming languages with constructs from Bayesian modelling like random variables, distributions, sampling and conditioning. Frameworks supporting probabilistic programming (e.g., Pyro) allow fully automated Bayesian inference, including for rich models that include neural networks. I will present how we use probabilistic programming for voucher information extraction at Skanned.com. I will discuss two concrete models which we have been working on: one for grouping similar vouchers and another for matching keywords against features. We will discuss the high-level constructs used in these models, the challenges we experienced in describing them, and the preliminary results of running inference against them.

Coffee and cake (15:00-15:30)

Bayes@Lund 2019: Bayesian methods for the close to unseen (15:30-16:50)

time	[id] title
15:30	**[16] How to deal with a noisy zero – a simple Bayesian treatment for small angle neutron scattering** *Presenter: HOLMES, Alexander* Neutron scattering measurements are an ideal case for Bayesian analysis – statistics are limited, measurement time is expensive and there is often relevant background information. I will present an example of small angle neutron scattering from superconducting vortex lattices. Most of the signal detected is irrelevant, and contributes nothing but noise to the final result. A Bayesian treatment of the results, allows a huge enhancement of the signal to noise ratio, and treats missing data sensibly. I will further argue that Bayesian analysis offers a huge amount to the scattering community and would benefit significantly from more systematic support from institutions such as the ESS. [A. T. Holmes, Phys. Rev. B 90, 024514][1] [1]: https://doi.org/10.1103/PhysRevB.90.024514
15:50	**[17] Bayesian inference of conformational ensembles from small-angle scattering data** *Presenter: POTRZEBOWSKI, Wojciech* Small-angle scattering (SAS) uses x-ray or neutron scattering at small angles to investigate the structure of materials at the scale about 1-100nm. SAS is uniquely suited to study the conformational ensembles adopted by multidomain proteins. However, analysis is complicated by the limited information content in SAS data and care must be taken to avoid constructing overly complex ensemble models and fitting to noise in the experimental data. To address these challenges, we developed a method based on Bayesian statistics that infers conformational ensembles from a structural library generated by all-atom Monte Carlo simulations. The method involves a fast model selection based on variational Bayesian inference that maximizes the model evidence, followed by a complete Bayesian inference of population weights.

16:10 **[18] Bayesian determination of the effect of a deep eutectic solvent on the structure of lipid monolayers**

Presenter: MCCLUSKEY, Andrew

We present a unique insight from Bayesian-driven modelling for a series of lipid monolayers at the air-deep eutectic solvent (DES) interface using reflectometry measurements.
A chemically-consistent modelling approach shows that the lipid monolayers at the air-DES interface are similar to those on water, while removing the need for water-specific constraints.
Furthermore, the use of Markov-chain Monte Carlo sampling enables the quantification of inverse uncertainties and parameter correlations in the modelling approach.
Finally, we discuss limitations present in the use of Bayesian methods for reflectometry analysis, and outline future work that will be conducted to overcome these.

16:30 **[11] Automatic Learning of Summary Statistics for Approximate Bayesian Computation Using Deep Learning**

Presenter: WIQVIST, Samuel

Learning summary statistics is a fundamental problem in Approximate Bayesian Computation (ABC). The problem of learning summary statistics is in fact the main challenge when applying ABC in practice, and affects the resulting inference considerably. Deep learning methods have previously been used to learn summary statistics for ABC. Here we introduce a novel deep learning architecture (Partially Exchangeable Networks, PENs), with the purpose of *automatically* learning summary statistics for ABC. Our case studies show that our methodology outperforms other popular methods, resulting in more accurate ABC inference for Markovian data.

Joint work with Pierre-Alexandre Mattei, Umberto Picchini and Jes Frellsen.

Closing remarks (16:50-17:00)

- Presenters: BÅÅTH, Rasmus; SAHLIN, Ullrika