ASG "Quantifying and Communicating Uncertainty: Challenges and Opportunities" 2015–2016 Final report

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The advanced study group "Quantifying and Communicating Uncertainty: Challenges and Opportunities" (ASG in the rest of this document) has received 100,000 sek from Pufendorf Institute in November 2015. We organized a number of well attended events that have resulted in the participation of researchers from several institute/departments at Lund University and beyond. Our events have been a mix of focus group meetings, workshops and a conference. The main theme, around which all events and discussions were gravitating, was uncertainty quantification using Bayesian methodology. There is an immense body of work conducted on such methodology, especially from the last 30 years, but very little is taught at Lund University, hence the need to increase awareness via *accessible* workshops. With accessible we mean that we tried to construct events having broad appeal, no matter the background of the audience. In fact, the audience ended up being very heterogeneous, with participation from many different departments. We believe our initiatives were overall successful and very well received.

We think we have contributed in increasing awareness at Lund University about important scientific methods that are fundamental for research, data analysis, modelling and uncertainty quantification.

We would like to thank Pufendorf Institute for this opportunity and hope to organize more events of this kind for the benefit of LU as a whole.

The events organized by the ASG were:

1. "Communicate uncertainty with society", 2 December 2015. Responsible: Ullrika Sahlin

2. workshop on "Bayesian methods using Stan" with Aki Vehtari, 10 December 2015. Responsible: Umberto Picchini

3. seminar and hands-on, Bayesian Inference and Prior-data Conflict, with Gero Walter, 15 December 2015. Responsible: Ullrika Sahlin

4. workshop on Bayesian inference, with Eric-Jan Wagenmakers, 4 February 2016. Responsible: Rasmus Bååth

5. conference Bayes@Lund, 5 February 2016. Responsible: Rasmus Bååth and Ullrika Sahlin

6. workshop on Approximate Bayesian Computation with Michael Blum, 10 March 2016. Responsible: Umberto Picchini

7. workshop on R-INLA (Integrated Nested Laplace Approximation) with Geir-Arne Fuglstad, 14-15 April 2016. Further details will follow. Responsible: Johan Lindström

8. open discussion (in Swedish) "Osäkra risker och politiskt beslutsfattande", 28 April 2016. Responsible: Ullrika Sahlin

Most of the activities listed above have detailed individual webpages, collected at `http://www.maths.lth.se/matstat/staff/umberto/bayes-asg.html`. All activities were free for registered participants, including refreshment.

All our events have been announced widely, thanks to the `Bayes@Lund` email-list set-up by Rasmus Bååth about 4 years ago. The email-list is still up and running at `https://www.lucs.lu.se/bayes/`. This has been a fundamental tool to inform LU researchers about our activities and we hope to keep using it to increase collaboration and discussion across disciplines.

Here follow the descriptions of the ASG events.

Communicate uncertainty with society

On 2nd December senior researchers were invited to a focus group discussion about their interaction with society. For some, a key factor to understand and succeed in interacting with stakeholders was the use of decision theory to understand the needs of the stakeholders and to use a systematic approach to identify solutions to meet these needs. Two models for communication were

discussed, the transfer model, where communication occurs at the end of a research process, and the interaction model, where communication occurs (more or less) in all steps of a research process. The latter model allows communication of scientific uncertainty to be adapted to the needs of the stakeholders, but may on the other hand, be a problem for the scientific integrity of the researcher. Both models are useful and their lesson was that the interaction model opens up for a more effective communication (both ways).

Workshop on "Bayesian methods using Stan"

This was a workshop introducing topics in Bayesian inference, computational tools and modelling. Very little background knowledge of statistical methodology was expected from participants. Topics included: intro to the Bayesian way of thinking uncertainties; intro to Monte Carlo methods for Bayesian inference; Bayesian inference using the Stan programming language; groups comparison, standard linear models, generalised linear models; examples of further possibilities offered by Stan; discussion and question-and-answer around data provided by participants.

- Date: 10 December 2015.

- length: about 3.5 hrs of methodology and 3.5 hrs of computer hands-on.

- chair: the event was chaired by Assoc. Prof. Aki Vehtari from Aalto University, Finland.

- Attendance: 40 people registered for the event, from a number of institutions at LU (including Environment, Psychology, Mathematics, Biology) but also Copenhagen and Linköping.

Practical hands-on sessions used the (free) Stan software.

Bayesian Inference and Prior-data Conflict

Gero Walter from Technische Universiteit Eindhoven talked on the problem of prior-data conflict, that is when the information from data is in conflict with prior assumptions. Prior-data conflicts is a problem for small data samples. The talk was followed by a hands on session on how to handle and mitigate prior-data conflict in practice, using the R software.

Workshop on Bayesian inference

In this two-part workshop Eric-Jan Wagenmakers introduced the audience to Bayesian statistics. In the first part of the workshop, the principles of Bayesian parameter estimation and hypothesis testing was illustrated and discussed. The second part of the seminar featured a tour of JASP, a software program that showcases the practical feasibility of the Bayesian agenda.

- Date: 4 February 2016.

- Length: about 2.5 hrs

- Chair: the event was chaired by Prof. Eric-Jan Wagenmakers from University of Amsterdam, Netherlands.

- Attendance: 62 people registered from all parts of Lund University, but also from Copenhagen, Stockholm and Lindköping University.

Bayes@Lund

The purpose of this conference was to bring together researchers working with or interested in Bayesian methods. Bayes@Lund aimed at being accessible to researchers with little experience on the methods while still being relevant to experienced practitioners. The focus was on how Bayesian methods are used in research, advantages over classical alternatives, and how their use and teaching can be encouraged.

The conference included a number of short contributed talks, an invited presentation by Robert Grant and a keynote presentation by Eric-Jan Wagenmakers. Overall the event had 8 presentations. Details can be found at the conference home page: `http://www.lucs.lu.se/bayes-at-lund-2016/`.

- Date: 5 February 2016

- Length: 4.5 hours of presentations and tutorials.

- Chair: The event was chaired by Rasmus Bååth and Ullrika Sahlin and featured 6 regular speakers and 2 keynote speakers (Robert Grant and Eric-Jan Wagenmakers)

- Attendance: 92 people registered, again from all parts of Lund University, but also from Copenhagen, Stockholm and Lindköping University.

A Practical Introduction To Approximate Bayesian Computation

This was a workshop introducing approximate Bayesian computation (ABC). Starting from the beginning of the 90's ABC has provided a mean to perform statistical inference for complex models. With "complex models" we mean those situations where the likelihood function is unavailable in closed form or is computationally too expensive to calculate/approximate. Applications of ABC are ubiquitous in all research areas, especially natural sciences. Practical examples and software hands-on practicals enriched the event. No previous knowledge of the methodology was expected from participants.

- Date: 10 March 2016.

- length: about 3 hrs of methodology and 2 hrs of computer hands-on.

- chair: the event was chaired by Dr. Michael Blum from CNRS Grenoble, France.

- Attendance: 26 people registered for the event, from a number of institutions at LU (including Environment, Psychology, Mathematics, Biology, Cognitive Science, Sociology) but also Copenhagen, Gotheborg, Linköping and Stockholm.

Practical hands-on sessions used the R software.

workshop on R-INLA (Integrated Nested Laplace Approximation)

This 2-day workshop introduced Bayesian inference for latent Gaussian models, a very flexible model class that can be used to analys data from many different fields and different applications. The workshop was chaired by Geir-Arne Fuglstad from NTNU in Trondheim, who was help by a NTNU PhD-student during the practical sessions. The group at NTNU is very active in developing both methodology and free software for the latent Gaussian models, and the workshop covered both underlying methodology and the use of available free software to estimate the models. The availability of good, free software makes it much more likely that advanced statistical methodology can be used by non-statisticians, thus the workshop put special focus on available software. The workshop assumed basic prior knowledge of statistics but no specific knowledge regarding either the methodology or computational tools.

- Date: 14–15 April 2016.

- length: about 8 hrs of methodology and 4 hrs of computer hands-on.

- chair: the event was chaired by Geir-Arne Fuglstad from the Norwegian University of Science and Technology, Trondheim, Norway.

- Attendance: 22 people registered for the event, from a number of institutions at LU (including Biology, CEC, Cognitive Science, Mathematics, Physical Geography and Ecosystem Science, and Psychology) but also Copenhagen, the Netherlands, Germany and Czechia.

Practical hands-on sessions used the (free) R-INLA software.

Open discussion "Osäkra risker och politiskt beslutsfattande"

We invited decision makers and politicians to participate in a discussion about uncertainty in regulatory and political decision making. The seminars were held in Swedish and had 10 participants. Topics and speakers are:

- Uncertainty and its description - Ullrika Sahlin, Environmental science, Lund

- Uncertaint and decision making - Åsa Knaggård, Political science, Lund

- Uncertainty and transparency - Ragnar Loftstedt, Kings college, London, UK

We discussed the new definition of risk which has been developed to better reflect the need to consider uncertainty of varying degrees of severity. The seminar was followed by an oped in Sydsvenskan Aktuella frågor Monday May 23rd 2016 with the title "Vem bär ansvar för att osäkerhet hanteras på bästa möjliga sätt? [How takes the responsability that unceratinty is treated in the best possible way?].