Applied Bayesian Inference: Course Preparation

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1 Goal

Social scientists increasingly apply the Bayesian approach to diverse kinds of research topics. This development is due to a series of its attractive features: e.g. handling aggregate data without sampling processes, analysing small N data, estimating models with complex likelihood functions. Furthermore, the increasing capacity of modern computers enables a wider range of researchers to conduct such computationally intensive estimations.

Despite of these advantages there is still backlog demand in respect to several points: First, it is not widely enough acknowledged that Bayesian statistics and conventional statistics are based on different views concerning theory and data. Second, the literature, including text books, is in general too technical to motivate most social scientists to apply Bayesian analysis to their own research questions. Third, the programs needed for Bayesian analysis is not user friendly enough for most social scientists.

The course aims to close these gaps. First, the course provides a well-grounded conceptional background for Bayesian analysis. Second, participants will be guided how to read the literature concerning Bayesian statistics and interpret the results. Third, this course gives a practical introduction in a specific software for Bayesian analysis with social science examples.

More specifically, the course covers the following topics: Fundamentals of Bayesian analysis, Bayesian estimation using MCMC and estimation of various regression models (binary logit/probit, poisson, multi-level, robust regression etc.) in Bayesian framework. The course consists of lectures and lab sessions. The lecture deals with relevant background knowledge as well

as specific skills for Bayesian analysis. In lab sessions, these skills are applied to political and social science data. Hence, course participants also learn the basic knowledge of JAGS which is needed to conduct Bayesian estimation.

Participants are required to have basic knowledge in statistical analysis including regression models with different types of dependent variables. Furthermore, in lab sessions participants learn how to use JAGS from R. Therefore, the basic knowledge in R is also recommended.

Note that this is an introductory course. This course, therefore, cannot thoroughly treat the wide range of statistical models and further advanced topics in Bayesian statistics. For those who have basic knowledge in Bayesian statistics and can conduct different types of regression analysis using JAGS, this course is not adequate.

2 Preparation of your own laptop computer (optional)

Please install the following softwares prior to the course.[1]

- R

- RStudio

- JAGS

Attention!: This manual assumes that you are on-line and Windows-user. But all of the softwares are also available for Macintosh and Linux.

2.1 R

1. `http://www.r-project.org/`.

2. Go to `CRAN` (on the left column).

3. Choose a mirror-server in your neighbor (Austria, Germany, Switzerland, etc.).

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[1]If possible, please bring your extension code for the power supply. Eventually, only limited number of plugs is available in the room.

4. Go to `Download R for Windows` (below „Linux", „MacOS X").

5. Go to `base`.

6. Click `Download R X.X.X for Windows` (`X.X.X` should be the most recent version).

7. Install the program.

2.2 RStudio

1. `http://www.rstudio.com//` or google with "RStudio".

2. Go to `Download now` (under "Powerful IDE for R").

3. Go to `Download RStudio Desktop`.

4. Download the file under `Recommended For Your System`.

5. Install the program.

6. Install a package `rjags`.[2]

   - Start `RStudio`.
   - Click the tab `Packages` on the bottom-right window.
   - Click `Install Packages`
   - In the pop-up window, write `rjags`
     below `Packages (separate multiple with space or comma):`
   - Click `Install`

2.3 JAGS

1. Go to the homepage of JAGS: `http://mcmc-jags.sourceforge.net` or google with "JAGS"

2. Follow the instructions to install JAGS.

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[2]Package `rjags` is an interface which enable us to use JAGS in R.

3 Further Preparation

3.1 Reading

As stated above, one of this course's goals is to guide participants how to read the literature using Bayesian statistics. For this reason, you only need to read the book chapter:

> Shikano, Susumu (2014) Bayesian estimation of regression models, Henning Best and Christof Wolf, eds. Regression Analysis and Causal Inference, Sage. pp. 31-54.

This chapter will give you some first impressions of Bayesian inference. Do not worry if you cannot understand everything. But please try to go through this chapter. It would help your understanding the topics during the course, which in turn would facilitate your understanding the text. After reading the chapter you can proceed further reading assigned to each session.

In this course, however, follow-up learning is more important. This includes further reading which I suggest in my course and replicating exercises in the course for yourself.

3.2 Lab session

For the lab session you do not need to prepare except for installation of the softwares above. Data and programs will be made available by the instructor.

If you are interested to conduct Bayesian inference for your own research project. You can also bring your own data and conduct some estimation. However, please make sure first that you can replicate everything which the instructor prepared for the course.