

**FAU – School of Business, Economics and Society**  
**Chair of Statistics and Econometrics**  
**Bayesian econometrics**  
**Summer 2022 – Syllabus**

**Instructor:**

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**Overview:** This course is an introduction to Bayesian statistics. It focuses primarily on models that are relevant in economics. The course will give students the theoretical knowledge and practical skills to apply Bayesian techniques in a wide range of empirical applications. We will start with the foundations of Bayesian statistics and then cover estimation of linear and non-linear regression models as well as probit models and Bayesian vector autoregressions. The course will also cover various numerical methods needed to estimate those models. Students will learn how to practically implement the covered methods using the software R. Students will be able to use the covered methods on their own and to understand academic papers that use Bayesian methods in empirical analyses. The course will be self-contained in the sense that no prior knowledge of both Bayesian statistics and R are required. However, students should have solid knowledge of the basics of statistics and econometrics and will profit from prior experience with R or other econometric software packages.

**Main textbook:** Koop, G. (2003), Bayesian Econometrics, Wiley, West Sussex.

**Other literature:** Announced during the course.

**We teach the course over the period 26<sup>th</sup> April to 30<sup>th</sup> June.** Each week, we have either a lecture or an exercise session in the following **three time slots:**

Tuesday: 11:30h – 13:00h, room LG 4.109

Wednesday: 11:30h – 13:00h, room LG 4.109

Thursday: 8:00h – 9:30h, room LG 4.109

**Lectures:** 26.4./28.4./3.5./5.5./10.5./12.5./17.5./19.5./24.5./31.5./1.6./14.6./21.6.

**Exercise sessions:** 27.4./4.5./11.5./18.5./25.5./2.6./15.6./22.6./23.6./28.6./29.6./30.6.

**Final examination:** 5<sup>th</sup>/6<sup>th</sup> July, 2022 (oral exams of about 20 minutes)

**Grading:** Grading is based 100 % on the oral exam.

**Course requirements:** Course participants are strongly advised to ...

- **Attend.** You can only fully benefit from this course if you attend both lectures and exercises regularly because the course content is cumulative, meaning that later topics rely heavily on stuff covered in the previous weeks.

- **Prepare.** Ideally, do the assigned readings before the lecture and come to class prepared to discuss them and to ask any questions that you may have.
- **Follow the website.** I will make course material available through the course website on StudOn. I will also make announcements using this platform.
- **Code.** Your learning gains will be much higher if you regularly work on the R assignments, which ask to implement the material that we cover in the lectures. Do not underestimate how much coding an approach helps understanding it!

### Course outline

<u>Topic 1:</u>	The idea of Bayesian statistics / Bayes' theorem
<u>Topic 2:</u>	Prior + Likelihood = Posterior
<u>Topic 3:</u>	Linear regressions with conjugate priors
<u>Topic 4:</u>	Linear regressions with many explanatory variables / MC integration
<u>Topic 5:</u>	Linear regressions with independent priors / Gibbs sampler
<u>Topic 6:</u>	Linear regressions with inequality constraints / importance sampling
<u>Topic 7:</u>	Non-linear regression models / Metropolis-Hastings algorithm
<u>Topic 8:</u>	Probit models
<u>Topic 9:</u>	Forecasting
<u>Topic 10:</u>	Model comparison / Bayesian model averaging
<u>Topic 11:</u>	Bayesian VAR models
<u>Topic 12:</u>	Bayesian estimation of DSGE models / Review of course content

### R Software

R is a free software environment. You can download R using any of the links on the following website: <https://cran.r-project.org/mirrors.html>.

We recommend that you use RStudio to organize your codes. You can download a free copy of RStudio Desktop [here](#) (just use the download button that is most to the left).

We will use the first exercise session to explain how to install R/RStudio and to make sure that it works on everyone's laptop. The first exercise sessions cover the basics of programming in R.

There are also many excellent online courses for learning R available online which you might want to consult if you do have no prior experience with R at all. We recommend the following:

- "[Basiskurs R/RStudio](#)" provided by our chair (course language is German)
- A free course on [Coursera](#) offered by Johns Hopkins University;
- The book "R Programming for Data Science" by one of the authors of the Coursera course;
- Many tutorials on various aspects of R offered via the [swirl project](#);
- The course "[Topics in R Statistical Language](#)" offered by PennState University.

The most important thing to enhance your programming skills and to master the implementation of econometric methods is to write a lot of code. Do not be afraid of bugs!