my-ebook

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Table of contents

1 introduction

2 introduction

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Back to home page

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3 Bayesian Linear Modeling (Winter Semesters, MSc programs)

3.1 Introduction: What this course is about

This course provides an introduction to Bayesian data analysis using the probabilistic programming language **Stan**.
We will use a front end software package called **brms**.

This course is for:

- MSc Linguistics (MM5, MM6)
- MSc Cognitive Systems
- MSc Cognitive Science

Please see the PULS FAQs to find out how the sign-up system works (in German).

We will be using the software R and RStudio, so make sure you install these on your computer.

Topics to be covered:

1. Basic probability theory, random variable theory (including jointly distributed RVs), probability distributions (including bivariate distributions)
2. Using Bayes' rule for statistical inference
3. An introduction to (generalized) linear models
4. An introduction to hierarchical models
5. Measurement error models
6. Mixture models
7. Model selection and hypothesis testing (Bayes factor and k-fold cross-validation)

3.2 Times, location

At Golm campus, Potsdam:
Seminar: Wednesdays 10:15-11:45AM, II.14.009
Übung: Mondays 14:15-15:45AM, II.14.009 (Haus 14 ground floor)

3.3 Lecture notes

Download from here.

3.4 Homework

Details to be provided.

3.5 Grading

Details to be provided.

3.6 Moodle website

All communications with students in Potsdam will be done through this website.

4 Schedule

Lecture	Topic	Reading	HW
(1) Oct 15	no class		
(2) Oct 17 + 22	Foundations I		HW 1
(3) Oct 24 + 29	Foundations II		HW 2
(4) Oct 31 + Nov 5	Introduction to Bayesian data analysis I		HW 3
(5) Nov 7 + 12	Introduction to Bayesian data analysis II		HW 4
(6) Nov 14 + 19	Linear models I		HW 5
(7) Nov 21 + 26	Linear models II		HW 6
(8) Nov 28 + Dec 3	Hierarchical linear models I		HW 7
(9) Dec 5 + 10	Hierarchical linear models II		HW 8
(10) Dec 12 + 17	Hierarchical linear models III		HW 9
(11) Jan 7	Review		
(12) Jan 9 + 14	Measurement error models		HW 10
(13) Jan 16 + 21	(Hierarchical) Mixture models		HW 11
(14) Jan 23 + 28	Bayesian workflow		HW 12
(15) Jan 30 + Feb 4	Model selection and hypothesis testing		HW 13

Part I

Preface

5 Why Read This Book?

This book is intended for MSc Chemistry students who want to develop a deep understanding of core chemistry concepts.

5.1 Target Audience

- MSc Chemistry students
- Advanced undergraduate students
- Anyone preparing for competitive exams involving Chemistry

5.2 What Will You Learn?

- Conceptual clarity in acid-base theory
- Buffers and equilibrium
- Spectroscopy fundamentals
- Statistical mechanics basics

6 Developing the right mindset for this book

One very important characteristic that the reader should bring to this book is a can-do spirit. There will be many places where the going will get tough, and the reader will have to slow down and play around with the material, or refresh their understanding of arithmetic or middle-school algebra. The basic principles of such a can-do spirit are nicely summarized in the book by Burger and Starbird (2012); also see Levy (2021). Although we cannot summarize all the insights from these books in a few words, inspired by the Burger and Starbird (2012) book, here is a short enumeration of the kind of mindset the reader will need to cultivate:

Spend time on the basic, apparently easy material; make sure you understand it deeply. Look for gaps in your understanding. Reading different presentations of the same material (in different books or articles) can yield new insights. Let mistakes and errors be your teacher. We instinctively recoil from our mistakes, but errors are ultimately our friends; they have the potential to teach us more than our correct answers can. In this sense, a correct solution can be less interesting than an incorrect one. When you are intimidated by some exercise or problem, give up and admit defeat immediately. This relaxes the mind; you've already given up, there's nothing more to do. Then, after a while, try to solve a simpler version of the problem. Sometimes, it is useful to break the problem down to smaller parts, each of which may be easier to solve. Create your own questions. Don't wait to be asked questions; develop your own problems and then try to solve them. Don't expect to understand everything in the first pass. Just mentally note the gaps in your understanding, and return to them later and work on these gaps. Step back periodically to try to sketch out a broader picture of what you are learning. Writing down what you know, without looking up anything, is one helpful way to achieve this. Don't wait for the teacher to give you bullet-point summaries of what you should have learned; develop such summaries yourself. Develop the art of finding information. When confronted with something you don't know, or with some obscure error message, use google to find some answers. Do not hesitate to re-read a chapter; often, one only understands a topic after one revisits the material. As instructors, we have noticed over the years that students with such a mindset generally do very well. Some students already have that spirit, but others need to explicitly develop it. We firmly believe that everyone can develop such a mindset, but one may have to work on acquiring it. In any case, such an attitude is necessary for a book of this sort.

7 intro

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8 summary

This is summary file .

References