Texts

Texts for this class are

Weiss, R. E. (2021). *Class notes*. Course notes will be placed on line for downloading. Permission granted to make copy for use with this class. There is also an older version available on the web site.

Gelman, Carlin, Stern, Dunson, Vehtari, and Rubin (**GCSDVR**) (2013). *Bayesian Data Analysis*. CRC Press. 3rd edition. Suggested book. I won't be referring to it during the course, but it is there if you would like something explained from a different direction, or if you would like to learn more. GCSDVR covers virtually everything that we might wish to cover if the course lasted for a full year and then some. This continues to be the canonical book on Bayesian statistics. It does assume a good grounding in statistics. All doctoral students should have a copy of this. I might suggest reading it second after Hoff's book.

Hoff, Peter D. (2009). A First Course in Bayesian Statistical Modeling. Springer. Suggested text, available in the bookstore. Designed to get scientists programming Bayesian MCMC algorithms in `R` as quickly as possible. Particularly recommended for non-statisticians. Quite a few people have really enjoyed this book. Arguably a best first book to read. Read as fast as you can. Overlaps less with the course material than some other books.

Hodges, James S. (2014). Richly Parameterized Linear Models. Additive, Time Series, and Spatial Models Using Random Effects. Chapman & Hall/CRC Press. I've just started reading this, but the beginning discussion is fantastic. He treats both Bayesian and non-Bayesian approaches. As random effects models are models that require Bayesian thinking to understand, this will end up being a good book to help you understand Bayesian models and Bayesian modeling.

Christensen, Ron; Johnson, Wesley O.; Branscum, Adam J.; Hansen, Timothy E. (2011). Bayesian Ideas and Data Analysis: An Introduction for Scientists and Statisticians. Chapman & Hall/CRC Press. Strongly recommended. (CJBH) The presentation in this book is closer to my own philosophy on statistics and statistical analysis than any other text, though see Hodges's book above.

Kadane, Jay (2011). Principles of Uncertainty. Chapman & Hall/CRC Press. Available as a free download from `http://uncertainty.stat.cmu.edu/`. The mathematics and mathematical statistics underlying Bayesian statistics. Kadane is one of the grand old men of Bayesian statistics with an amazing career. Recommended reading for all Biostat PhD students after reading CJBH.

Gelman, A. and Hill, J. (2006). Data Analysis Using Regression and Multilevel/Hierarchical Models. Cambridge University Press. Lower level text for non-Biostat/non-Stat majors on hierarchical models.

Software documentation

Martyn Plummer (2013) JAGS Version 3.4.0 User Manual. Get it from many places on the web including: 30 August 2013`http://sourceforge.net/projects/mcmc-jags/files/Manuals/3.x/` We'll be using this software in labs.

David Spiegelhalter, Andrew Thomas, Nicky Best, Dave Lunn (2003). WinBUGS User Manual. Available from the Help menu in WinBUGS, or hit F1. You will repeatedly need the Model Specification and Distributions chapters which document the functions and distributions respectively that are available in WinBUGS.

W. N. Venables, D. M. Smith and the R Development Core Team (2010). An Introduction to R. Available from the `R` "Help" Menu, under "Manuals (in PDF)". Read through page 80.

Brian J. Smith (2016). Bayesian Output Analysis Program (BOA) Version 1.1 User's Manual. Available from `https://cran.r-project.org/web/packages/boa/boa.pdf`.

Readings: BMMD

Recommended: BMMD (the older version) and GCSDVR and Hoff for everyone and then CJBH for everyone, but outlines are given for other books as well.

BMMD has 5 rough chapters and an appendix so far; please expect plenty of pot holes. Still, the material supports our class directly. It contains a lot of the likelihood calculation details that have to be skipped in class – those likelihood calculations are valuable for the practicing statistician, but may be an impediment for the applied quantitative researcher.

	Readings in Older	
Course Topic	BMMD	Comments
Intro	1	Sections 1.1 to 1.6
Describing Distributions	2	
1 parameter models	3	READ! A lot here so we can cover more advanced models in class. More mathematical than originally intended, and much more mathematical than required for success in the course
2+ parameter models	4,5	
Distributions	Appendix B	Summaries of distributions

Readings: Christensen, Johnson, Branscum, Hanson

CJBH is a wonderful book. I haven't been able to put it down. The mathematical level is a touch higher than needed for success in this class. This is possibly the most modern Bayes textbook currently available. Covers modeling, proper prior specification, computing, prediction and philosophy. Discusses priors carefully and correctly. Illustrates prior specification. Really the only book out there that does all that and with approximately the right percentages of attention. A friendly book with occasional jokes in the text. Probably will be easier to read after hearing about the material from me, than before.

We will cover roughly the first 11 chapters. Biostat doctoral students should read all of this. Biostat MS students should read as much as they can, but can skip the more mathematical sections. Chapter 15 is an introduction to Bayesian nonparametrics, which is a very useful and likely to be helpful for getting good jobs for some time into the future.

Course Topic	Readings in CJBH	Comments
Introduction	Chapter 1	Read
Introduction	Chapter 2	Read
Computation	Chapter 3	Read
Tools	Chapter 4	Skim quickly or (more likely) skip entirely. Non-Biostat students can skip this. Biostat PhD students should read at the end of the course. These tools are easier to understand after exposure to the course.
Likelihood calculations	Sections 4.3, 4.4	Helpful in understanding the calculations involved with Gibbs sampling and MCMC.
Prediction	Section 4.5	Prediction is a big thing for Johnson
Flat Priors	Section 4.6	Good discussion on flat priors.
Hierarchical Models	Section 4.12	When we get to hierarchical models/random effects models, do read this.
One and two samples	Chapter 5	Skip 5.4
Probabilities	Section 5.1	Read
Normal model	Section 5.2	Read
Counts	Section 5.3	Read

cont'd on next page

Course Topic	Readings in CJBH	Comments
Computation	Chapter 6	The whole thing is important for doctoral students and those interested in statistical computation (good for jobs!). But we won't cover sections 6.1 or 6.2
MCMC	Section 6.3 intro	Read as much as you can.
MCMC	Section 6.3.1	Somewhat mathematical, if you can't read it, skip it.
Gibbs sampling	Section 6.3.2	is what we're doing, and is worth understanding.
Metropolis	Section 6.3.3.	What we do when Gibbs doesn't quite work.
Slice sampling	Section 6.3.4	Can be omitted
Convergence	Section 6.3.5	Checking convergence. Important!
Regression	Chapter 7, 9	Read. 7 is an introduction, 9 is on normal linear regression
Logistic Regression	Chapter 8	Read.
Priors for logistic regression	Section 8.4 IS lab 3.	
Logistic random effects models	Section 8.5	Lab 5.
Linear Regression	Chapter 9	Read. Our lab 2. You'll read this after lab 2.
Correlated Data	Chapter 10.	Lab 4.
Count data	Chapter 11	While we don't really have a count data regression example, they are common and this is useful.

Hoff does things in a different order than we do, but you may find the different order of great help. The first 11 chapters match fairly well with different parts of what we will be doing. It is perhaps a bit terse. I recommend reading as much as possible even before the course starts.

Course Topic	Readings in Hoff	Comments
Intro	Chapter 1	
Intro	Chapter 2	Brief math stat coverage for a Bayes course. All necessary, except for the belief functions portion which is an unusual inclusion that I won't use.
One-parameter Models	Chapter 3	
Monte Carlo methods	Chapter 4	
Normal model	Chapter 5	
Gibbs Sampling	Chapter 6	
Two groups, multiple groups, hierarchical models	Chapter 8	
Multivariate normal, missing data, Wishart distribution	Chapter 7	
Linear Regression	Chapter 9	
Metropolis Hastings	Chapter 10	
Random Effects Models	Chapter 11	

Topics and corresponding reading in GCSR.

Course Topic	Readings in GCSR 2nd Ed
Intro	1
Describing Distributions	
Setting Priors	
1 parameter models	2
More complex models	3
Regression	14
Generalized Linear Models	16
Hierarchical Models	5, 15
Computing	10, 11
More on Computing	12, 13
Outliers	6
Mixture Models	18

Other useful books:

Bayesian Inference in Statistical Analysis (1973) by George E.P. Box and George C. Tiao. From the pre-Monte Carlo era. It features a lot of the likelihood calculations that this new era in Monte Carlo tends not to nurture in graduate students. Only criticism I would level these days is their emphasis on flat priors which is unfortunate. They have a wonderful emphasis on data analysis. Still, a one of a kind classic that I heartily recommend. I think I may have learned more from this book than from all my other graduate school (excepting regression) textbooks. Currently I am strongly recommending that my doctoral students read this book.

Bayesian Statistics, 2nd edition (2006) by James Press. Wiley Series in Probability and Statistics. I didn't appreciate the first edition, but the second edition has a very good table of contents. Further, Press gets some help on several important modern topics from known experts in those topics.

A very interesting book from a completely different perspective is *Bayesian Methods: An Analysis for Statisticians and Interdisciplinary Researchers (Cambridge Series in Statistical and Probabilistic Mathematics)* by Thomas Leonard and John S. J. Hsu, (2001). It is in paperback, so fairly inexpensive. It talks a lot about one type of computation and it has many examples.

Peter Congdon has published three Wiley books: *Bayesian Statistical Modeling* (2001) (second edition 2006), *Bayesian Models for Categorical Data* (2005), *Applied Bayesian Modeling* (2003). [And there is now a 4th book Applied Bayesian Hierarchical Models in 2010.] Each book has many worked examples, and there is associated WinBugs code at his web site for all the examples. If WinBugs doesn't have an example for you to start out with, you might try one of Congdon's books as a source. Example code and data for all four books is available from `http://webspace.qmul.ac.uk/pcongdon/`. Virtually required reference shelf material for the practicing Bayesian. Not sure you'd actually want to read all three books.

And now Congdon has a fourth book! Applied Bayesian Hierarchical Methods (2010). Chapman & Hall/CRC Press.

A number of good books on Bayesian computation have appeared of late. *Monte Carlo Statistical Methods*, Second Edition, Springer Verlag (2004),

by Christian Robert and George Casella is a good starting point. It also covers function maximization which is helpful to understand. Strongly recommended for doctoral students.

Markov Chain Monte Carlo (2006). Dani Gamerman and Hedibert F. Lopes. Chapman and Hall/CRC. Another basic MCMC computing text.

More advanced texts on Bayesian computing are *Monte Carlo Strategies in Scientific Computing* by Jun S. Liu (Springer, 2002) and *Monte Carlo Methods in Bayesian Computation* by Ming-Hui Chen, Qi-Man Shao, and Joseph G. Ibrahim (Springer 2000). Both books are by experts in the field who have contributed substantially to Monte Carlo methods.