Applied Bayesian Analysis
Biostatistics 234
Course Information

Instructor	**Robert Weiss**		
Office	CHS 51-269		
email	robweiss@ucla.edu		

Office Hours	No appointment needed;		
	Please stop by;		
	First come, first served.		
	Monday	10:00 – 10:50	zoom
	Thursday	11:00 – 11:50	zoom
	by email		
	and by appointment		

Lecture	Tuesday	10:00 – 10:50	Zoom
Lecture	Thursday	9:00 – 10:50	Zoom
Lab 1	Tuesday	11:00 – 11:50	Zoom

TA	**Ben Rogers**		
tentative			
Office Hours	Tuesday	12:00 – 12:50	Zoom
	Wednesday	12:00 – 12:50	Zoom
	And by appointment		
email	benwrogers@ucla.edu		

Course Website: `https://faculty.biostat.ucla.edu/robweiss/biostat234`

Texts

Weiss Extensive course notes, and computer labs will be made available on the web. Required. You may want to print these out or otherwise have available to read.

Gelman, Carlin, Stern, Dunson, Vehtari, Rubin (2013). Bayesian Data Analysis. 3rd edition, Chapman & Hall/CRC Press. The closest thing to a Bible on Bayesian statistics. [Suggested, particularly for doctoral students.]

Hoff, Peter D. (2009). A First Course in Bayesian Statistical Methods. Highly recommended. Good candidate for first text to read. When someone asks for an intro to Bayesian statistics, I tell them to read this book and call me in the morning. I suggest reading this as fast as possible, even before course starts. Suitable for Biostat and non-Biostat students alike. Does not overlap the course material as much as some other books.

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. Matches my philosophy of data analysis much better than other Bayes books.

Grading The grade is based upon homework assignments, lab assignments and Data Analysis projects. There are no exams.

Revise and resubmit all homework, labs and projects After homework and labs are returned, you have 1 week to correct any errors and turn them back in for an improved grade. Please turn in both the old homework/lab and your revised homework/lab. Grade is score on the resubmitted homework/lab. For DAP1 and Final DAP, extra time may be allowed depending on how long it takes to hand them back. Incompletes will be given if Final DAP quality is not sufficient for a grade of A. To get an incompletes you need to have all homework, all labs and the DAP1 turned in before finals week.

Labs	20%
Homework & Abstract	20%
Data Analysis Project	20%
Final Data Analysis Project	40%

All labs and homework is required. The Final-DAP-abstract counts as part of the homeworks.

Typing: All homework, labs and data analysis projects must be typed.

Final DAP is due Tue Mar 19 as a pdf by email `robweiss@ucla.edu`.

Grading Curve

A	94-100%
A-	91-93.999%
B+	88-90.999%
B	84-87.999%
B-	80-83.999%
C	Below 80%
F	Below 70%

Curve may be lowered (but not raised) at Professor's discretion.

`JAGS` **Software** Bayesian inference will be illustrated in the computer lab using `JAGS` called from `R` using `R2jags`. You will need to download and install `JAGS`and `R2jags`, and `R` on your own computer to do homework, labs and Data Analysis Projects (DAPs). Course emphasis will be on illustrating Bayesian modeling and inferences. `JAGS` is free, and can run a lot of different analyses.

`R` **Software** `R` is free and available from `http://www.r-project.org/`.

Intro to `R` There are tons of additional packages for R that perform many different analyses. Many other packages are helpful to have and download.
Start `R`. Under the "Help" menu, find "Manuals (in PDF)" and then "An Introduction to R". This is a friendly introduction to `R`. If not already familiar with R, **READ this ASAP**, through page 80.
`JAGS` **standalone software** You'll need to download some additional packages. First download and install `JAGS`.
Download `R2jags`. In `R`, go to the Packages menu. Select "Install Package(s)...". In the pop-up menu, select `R2WinBUGS`

and click ok. Numbers are alphabetized before letters. Capitals and lower case letters are intermingled.
Now repeat for the package "boa".

Computers

Regular labs meet on zoom. You need to install `R`, `JAGS`, and `R2jags` on your computer to work on assignments and labs and to do the data analysis projects. Other packages will be used on occasion as needed.

Labs Will take place on zoom.

Syllabus

1. Introduction to Bayesian reasoning
2. Unknown normal mean with normal prior
3. Bayes theorem
4. Summarizing densities & intro to various densities
5. 1 parameter examples, conjugate priors
   (a) normal normal example
   (b) Binomial beta
   (c) Poisson gamma
   (d) Uniform data
6. Specifying priors for a
   (a) mean
   (b) probability
   (c) variance
   (d) Poisson rate
7. Monte Carlo methods
8. ANOVA models
   (a) One sample
   (b) Two samples
   (c) Many samples
9. Regression

10. Meta-Analysis
11. Variable selection in regression
12. Hierarchical Random Effects Models
13. t-error models
14. Mixture models for outliers
15. Models for Missing Data
16. Diagnostics
17. Bayes factors and hypothesis testing

Learning Objectives and Competencies

item	Upon completion of this course, the student should be able to:
1	Understand the differences between Bayesian and classical inference.
2	Understand, specify and apply Bayesian models as a means of addressing scientific and public health issues, including:
	a Bayesian models and priors for a single sample of data.
	b Bayesian regression models with proper priors.
	c Bayesian random effects hierarchical models.
	d Bayesian models for variable selection, outlier accommodation and missing data.
3	Fit these models in `JAGS`.
4	Present the results from a Bayesian analysis to biostatisticians, public health professionals and scientists.