

Bayesian Statistics, STAT 4520  
Fall 2020

1 General Information

Instructor: Kate Cowles, 374 SH, 335-0727  
kate-cowles@uiowa.edu

Zoom office hours: T 2:00 - 3:00
W 1:00 - 2:00 p.m.
Th 1:30 - 2:30 p.m.
Please feel free to make appointments to Zoom with me outside of office hours, and to send me questions by e-mail.

Department: Statistics and Actuarial Science, 241 SH

DEO: Kung-Sik Chan, 241 SH, 335-0712
kung-sik-chan@uiowa.edu

Lectures: M, W, F 11:30 - 12:20  Zoom link in ICON page
Lab: Some M & F 11:30 - 12:20  Zoom link in ICON page

Web page: icon.uiowa.edu

Textbook: Cowles, Applied Bayesian Statistics  
(free electronic access at 
Albert, Bayesian Computation with R  
in UI Engineering library)

2 Mode of presentation

The course will be presented online.

Lectures and computer labs will be offered live by Zoom at the scheduled time (MWF at 11:30 a.m.). To access the live Zoom sessions, click “Zoom” in the menu in the ICON page and then click on the link. You are expected to attend the live sessions. The Zoom lectures and labs will be recorded, and I will post links after the fact. Access to the recordings will be restricted to class members.

For the computer labs, you will want to run the computer code as I go along. You may do so in an ITC on campus (using headphones so as not to disturb other students) or you may use your own laptop. See the next section regarding needed software.

The way lectures and labs are offered may be changed during the course of the semester if the above plan doesn’t work well.

Office hours also will be by Zoom but will not be recorded.

You are welcome to email me at any time, and to request individual Zoom meetings if needed.
Let me know if you have problems with Internet access.

3 Information on textbook and software

You do NOT have to purchase the textbook. It is available electronically through the UI library. Use InfoHawk+ to search for “Applied Bayesian Statistics.”

I am currently writing a second edition of the textbook. Once we get through the first seven chapters in the first edition, beginning with chapter 8, I will post the revised chapters in the ICON web page.

This year we will use the JAGS software package instead of OpenBUGS as our main tool for fitting Bayesian models. We also will use R, Rstudio, and the R packages called rjags and coda. I have requested all the software that we need for class to be installed in the Schaeffer Hall and main library ITCs. You can also install it on your own laptop (Windows, Mac, or Linux), and it is all free.

4 Course goals and objectives

Through hands-on experience with real data from a variety of applications, students will learn the basics of designing and carrying out Bayesian analyses, and interpreting and communicating the results. Students will learn to use software packages including JAGS and R to fit Bayesian models.

5 Evaluation of students

5.1 Homework

Homework assignments will consist of data analysis on the computer, written interpretation of computer output, and other written questions. In general, homework will be assigned each Fri. and will be due by electronic submission the following Fri.

Exceptions to this schedule will be announced in class.

Show your work when solving written homework problems. For computer problems, turn in printouts of your commands or programs and their output.

You are encouraged to study with others. However, if you do work with others on homework assignments, please: a) write up your own assignment and make sure you completely understand all solutions that you submit, and b) write the names of the others in your study group on your assignment.

Late homework will not be accepted except as required by university policy, i.e. because of “illness, mandatory religious obligations, or other unavoidable circumstances or University activities.”
5.2 Take-home data analysis

Students will work individually to carry out a complete Bayesian analysis of a real dataset assigned by the instructor. This will involve:

- specifying an appropriate Bayesian model
- determining appropriate values for prior parameters
- fitting the model using R and JAGS
- checking MCMC convergence
- analyzing the output using the R package coda
- reporting and interpreting the results

Each student will submit a paper that is two to three pages in length plus an appendix containing the code for the data analysis.

The take-home data analysis will be assigned on Mon. Nov. 16 and will be due on Fri. Dec. 4.

Note: if you wish to analyze a dataset of your own choosing, or to do a small project of another kind that showcases knowledge and skills related to this class, you may contact the instructor by Mon. Nov. 9 to propose your idea.

5.3 Exams

There will be two 50-minute online midterm exams and one comprehensive 1-hour online final. Students may use one 8-1/2 x 11 in. sheet of paper with their own notes for each midterm, and three sheets for the final.

Missed exams may be made up only with documentation of reasons required by university policy (see “Late Homework” above).

Exam dates and times:

<table>
<thead>
<tr>
<th>Exam</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm 1</td>
<td>Fri. 09/25</td>
<td>in class period</td>
</tr>
<tr>
<td>Midterm 2</td>
<td>Fri. 11/06</td>
<td>in class period</td>
</tr>
<tr>
<td>Final</td>
<td>TBA</td>
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</tbody>
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5.4 Grading

The course components will be weighted as follows:

- Homework: 15%
- Midterms: 40% (20% each)
- Take-home data analysis: 20%
- Final: 25%

Grading will be on a curve, with +/- grades used. A grade of A+ represents exceptional work and rarely is awarded.

6 Extra Help

The Statistics Tutorial Lab gives free tutorial assistance to students in some elementary Statistics courses. In addition, several graduate students have volunteered to independently tutor students in various Statistics courses at mutually arranged times and fees. Please check the web site [www.stat.uiowa.edu/courses/tutoring.html](http://www.stat.uiowa.edu/courses/tutoring.html) for tutoring details.

7 College of Liberal Arts and Sciences: Policies and Resources

Absences and Attendance

Students are responsible for attending class and for contributing to the learning environment of a course. Students are also responsible for knowing their course absence policies, which will vary by instructor. All absence policies, however, must uphold the UI policy related to student illness, mandatory religious obligations, including Holy Day obligations, military service obligations, unavoidable circumstances, or University authorized activities. Students may use the CLAS absence form to aid communication with the instructor who will decide if the absence is excused or unexcused. The form is on ICON in the top banner under “Student Tools.” More information is at [https://clas.uiowa.edu/students/handbook/attendance-absences](https://clas.uiowa.edu/students/handbook/attendance-absences).

Academic Integrity

All undergraduates enrolled in courses offered by CLAS have, in essence, agreed to the College’s [Code of Academic Honesty](https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code). Misconduct is reported to the College, resulting in suspension or other sanctions, with sanctions communicated with the student through UI email. Visit this page for information: [https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code](https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code)
Accommodations for Disabilities

UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as mental health, attention, learning, vision, and physical or health-related condition) by registering with Student Disability Services (SDS). The student is then responsible for discussing specific accommodations with the instructor. More information is at https://sds.studentlife.uiowa.edu/.

Administrative Home of the Course

The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and related policies. Other colleges may have different policies. CLAS policies may be found here: https://clas.uiowa.edu/students/handbook.

Class Behavioral Expectations

Students are expected to comply with University policies regarding appropriate classroom behavior as outlined in the Code of Student Life. This includes the policies and procedures that all students have agreed to regarding the Steps Forward for Fall 2020 in response to the COVID-19 pandemic. Particularly, all students are required to wear a face covering when in a UI building, including a classroom. In addition, the density of seats in classrooms has been reduced; in some instances, this will allow 6 feet or more between students while other cases, it may be less. Regardless, wearing a face covering and maintaining as much distance as possible are vital to slowing the spread of COVID-19. In the event that a student disrupts the classroom environment through their failure to comply with the reasonable directive of an instructor or the University, the instructor has the authority to ask that the student immediately leave the space for the remainder of the class period. Additionally, the instructor is asked to report the incident to the Office of Student Accountability for the possibility of additional follow-up. Students who need a temporary alternative learning arrangement related to COVID-19 expectations should contact Student Disability Services (https://sds.studentlife.uiowa.edu/fall-2020/covid-19-temporary-learning-arrangements/) +1 319 335-1462).

Class Recordings: Privacy and Sharing

Some sessions of a course could be recorded or live-streamed. Such a recording or streaming will only be available to students registered for the course. These recordings are the intellectual property of the faculty, and they may not be shared or reproduced without the explicit written consent of the faculty member. Students may not share these sessions with those not in the class; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and, in some cases, a violation of the Federal Education Rights and Privacy Act (FERPA).
Communication and the Required Use of UI Email

Students are responsible for official correspondences sent to their UI email address (uiowa.edu) and must use this address for all communication within UI (Operations Manual, III.15.2).

Complaints

Students with a complaint about an academic issue should first visit with the instructor or course supervisor and then with the Chair of the department or program offering the course; students may next bring the issue to the College of Liberal Arts and Sciences; see this page for more information: https://clas.uiowa.edu/students/handbook/student-rights-responsibilities.

Final Examination Policies

The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this information. No exams of any kind are allowed the week before finals with very few exceptions made (for labs, ESL and some world language courses, and off-cycle courses): https://registrar.uiowa.edu/final-examination-scheduling-policies.

Nondiscrimination in the Classroom

The University of Iowa is committed to making the classroom a respectful and inclusive space for people of all gender, sexual, racial, religious, and other identities. Toward this goal, students are invited in MyUI to optionally share the names and pronouns they would like their instructors and advisors to use to address them. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University’s Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (https://diversity.uiowa.edu/eod; +1 319 335-0705).

Sexual Harassment

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, please see https://osmrc.uiowa.edu/.
8 Syllabus (may be updated)

08/24 - 08/28 Review of probability and Bayes’ theorem
Reading: Cowles, Chapters 1 and 2
Lab Fri. 08/28
08/31 - 09/04 Bayesian inference for proportions
Reading: Cowles, Chapter 3
09/07 - 09/11 Summarizing posterior distributions
09/07 Labor Day; no class
Reading: Cowles, Chapters 4 and 5
09/14 - 09/18 Other 1-parameter models
Reading: Cowles, Chapters 5 and 6
Lab Mon. 09/14
09/21 - 09/25 Intro to multiparameter models
Reading: Cowles, Chapter 7
Midterm 1, Fri. 09/25
09/28 - 10/02 Bayesian computing
Reading: Cowles, Chapter 8 (new edition)
Lab Mon. 09/28
10/05 - 10/09 Hierarchical models
Reading: Cowles, Chapter 9; selections from JAGS manual
10/12 - 10/16 Hierarchical models; More Bayesian computing
Reading: Cowles, Chapter 9; Albert, selected sections
Lab Mon. 10/12
10/19 - 10/23 Bayesian Regression
Reading: Cowles, Chapter 10
10/26 - 10/30 Hierarchical regression models
Reading: Cowles, Chapter 10
Lab Mon. 10/26
11/02 - 11/06 Hierarchical, continued; Other software
Midterm 2, Fri. 11/06
Reading: Cowles, Chapter 11
11/09 - 11/13 Model checking and comparison; Hypothesis testing, etc.
Lab Mon. 11/09
Reading: Cowles, Chapter 12
11/16 - 11/20 Special topics
Take-home data analysis assigned Mon. 11/16
Lab. Mon. 11/16
Reading: Cowles, Chapter 13
11/23 - 11/27 No class
Happy Thanksgiving!
11/30 - 12/04 Special topics
Take-home data analysis due Fri. 12/04
12/07 - 12/11 Review and take-home data analysis critiques
Projects due 12/09
Lab Mon. 12/07
Finals week Final exam