

**PubH 6431 Section 101 Class #87608**  
**Topics in Hierarchical Bayesian Analysis**  
**May Session 2017**

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**Credits:** 1 credit

**Meeting Days/Times:** May 30, 31 1:00 – 4:30 p.m.  
June 1, 2 1:00 – 5:00 p.m.

**Meeting Place:** Mayo C381 Computer Lab

**Instructor:** Bradley P. Carlin, PhD  
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**Office Hours:** By Appointment

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**I. Course Description**

Hierarchical Bayesian methods combine information from various sources and are increasingly used in biomedical and public health settings to accommodate complex data and produce readily interpretable output. This course will introduce students to Bayesian methods, emphasizing the basic methodological framework, real-world applications, and practical computing.

## Competencies

The core competencies for public health professionals are a consensus set of skills identified by the Council on Linkages (CoL) between academia and public health practice as being desirable for the delivery of the essential public health services. The CoL competencies identified for this course are:

### Domain 1: Analytic/Assessment Skills

- 1.4 Uses methods and instruments for collecting valid and reliable quantitative and qualitative data
- 1.9 Interprets quantitative and qualitative data
- 1.10 Makes community-specific inferences from quantitative and qualitative data
- 1.12 Uses data to address scientific, political, ethical, and social public health issues

### Domain 6: Public Health Science Skills

- 6.4. Applies the basic public health sciences (including, but not limited to biostatistics, epidemiology, environmental health sciences, health services administration, and social and behavioral health sciences) to public health policies and programs
- 6.9. Contributes to building the scientific base of public health

## II. Course Prerequisites

None.

However, it is recommended that students have mathematical coursework through at least college algebra, familiarity with desktop computing, and basic knowledge of statistical concepts (e.g., summarizing information through statistics, concepts of regression modeling).

This course is intended as a gentle introduction to both the mathematical and computing aspects of modern Bayesian methods, no prior calculus or software experience is assumed.

## III. Course Goals and Objectives

Upon completion of the course, students will be able to

- Formulate research questions,
- Develop Bayesian approaches to these questions,
- Implement models using available software,
- Interpret statistical output, and
- Understand advanced Bayesian methods applied in the scientific literature to complex data sets.

## IV. Methods of Instruction and Work Expectations

This course combines lectures with hands-on computing and written exercises. Students are expected to spend 1-2 hours reading materials and completing assignments before class. One problem set will be assigned on each of the first three days of class, due the following class. The goal is to provide practice on basic computation and interpretation of results, and these should be completed **independently**.

Students should attend class, participate in group exercises, and follow along with in-class computing exercises. Students will be assigned to small groups for a daily in-class exercise. Each group member will take a turn serving as group leader, and their performance of this role will comprise a large part of the participation grade.

## V. Course Text and Readings

### Required Text:

The required text for this course is *Bayesian Methods for Data Analysis*, 3<sup>rd</sup> ed. Bradley P. Carlin and Thomas A. Louis, Chapman and Hall/CRC Press, 2009. ISBN: 1584886978

### Pre-Course Assignment:

Prior to the start of class students are required to read/watch the following:

Thomas Matthews. Less likely than thought. *The National*. June 14, 2009.

URL: <http://www.thenational.ae/news/uae-news/science/less-likely-than-thought?pageCount=0>

Andrew Gelman. The Boxer, the Wrestler, and the Coin Flip: A Paradox of Robust Bayesian Inference and Belief Functions. *The American Statistician*. 60(2):146-50, 2006.

URL: <http://stat.columbia.edu/~gelman/research/published/augie4.pdf>

David Spiegelhalter. Professor Risk [video]. Cambridge, UK: University of Cambridge, 2009.

URL: <http://www.youtube.com/watch?v=a1PtQ67urG4>

Additional readings (available through the UMN Library) and assignments can be accessed through the course Moodle site.

#### Access Course Moodle Site

- go to [www.umn.edu](http://www.umn.edu) click on the “myU” button
- login with your University ID and password
- scroll to your course and click on the Moodle site link.

## VI. Course Outline/Weekly Schedule

<b><u>Pre-Course Assignment</u></b>	Reading and online assignments as posted above and also posted on course Moodle site.
<b><u>Day 1</u></b>	Introduction to Bayesian Thinking Basic definitions, contrast with classical (“frequentist”) methods, prior distributions, point and interval estimation, hypothesis testing
<b><u>Day 2</u></b>	Bayesian Modeling and Model Choice Basic distribution theory, link functions, elements of linear modeling (regression, logistic regression, ANOVA, etc.), Bayesian implementations and tools for model evaluation, comparison and selection; meta-analysis
<b><u>Day 3</u></b>	Bayesian Computing and Software Approximate approaches, Markov chain Monte Carlo (MCMC) methods, WinBUGS and R software packages, elementary examples (Poisson, binomial, and linear regression examples)
<b><u>Day 4</u></b>	Intermediate BUGS and Hierarchical Modeling: random effects models, nonlinear modeling, survival analysis, longitudinal modeling, others as time permits

## VII. Evaluation and Grading

Homework (4 assignments, each 25% of grade). Class participation is also required.

Late assignments will not be accepted without *prior notification*.

This course is offered A/F or S/N

- **A/F letter grade will be determined by total effort as follows:**
- **S/N option must complete all assignments to a C- level (70%):**

A 4.000	Represents achievement that is outstanding relative to the level necessary to meet course requirements. <b>94-100 points/percent</b>
A- 3.667	<b>90-93 points/percent</b>
B+ 3.333	<b>87-89 points/percent</b>
B 3.000	Represents achievement that is significantly above the level necessary to meet course requirements. <b>83-86 points/percent</b>
B- 2.667	<b>80-82 points/percent</b>
C+ 2.333	<b>77-79 points/percent</b>
C 2.000	Represents achievement that meets the course requirements in every respect. <b>73-76 points/percent</b>
C- 1.667	<b>70-72 points/percent</b>
D+ 1.333	<b>65-69 points/percent</b>
D 1.000	Represents achievement that is worthy of credit even though it fails to meet fully the course requirements. <b>60-64 points/percent</b>
F = below 60%	Represents failure (or no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I.

**For additional information, please refer to:**

<http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>.

### **Course Evaluation**

The SPH will collect student course evaluations electronically using a software system called CourseEval: [www.sph.umn.edu/courseeval](http://www.sph.umn.edu/courseeval). The system will send email notifications to students when they can access and complete their course evaluations. Students who complete their course evaluations promptly will be able to access their final grades just as soon as the faculty member renders the grade in SPHGrades: [www.sph.umn.edu/grades](http://www.sph.umn.edu/grades). All students will have access to their final grades through OneStop two weeks after the last day of the semester regardless of whether they completed their course evaluation or not. Student feedback on course content and faculty teaching skills are an important means for improving our work. Please take the time to complete a course evaluation for each of the courses for which you are registered.

### **Incomplete Contracts**

A grade of incomplete "I" shall be assigned at the discretion of the instructor when, due to extraordinary circumstances (e.g., documented illness or hospitalization, death in family, etc.), the student was prevented from completing the work of the course on time. The assignment of an "I" requires that a contract be initiated and completed by the student before the last official day of class, and signed by both the student and instructor. If an incomplete is deemed appropriate by the instructor, the student in consultation with the instructor, will specify the time and manner in which the student will complete course requirements. Extension for completion of the work will not exceed one year (or earlier if designated by the student's

college). For more information and to initiate an incomplete contract, students should go to SPHGrades at: [www.sph.umn.edu/grades](http://www.sph.umn.edu/grades).

**University of Minnesota Uniform Grading and Transcript Policy** - A link to the policy can be found at [onestop.umn.edu](http://onestop.umn.edu).

## VIII. Other Course Information and Policies

### **Grade Option Change** (if applicable)

For full-semester courses, students may change their grade option, if applicable, through the second week of the semester. Grade option change deadlines for other terms (i.e. summer and half-semester courses) can be found at [onestop.umn.edu](http://onestop.umn.edu). **The grading option for Public Health Institute courses may not be changed after the second day of class for 4-day courses. Grading options for 2 day courses may not be changed after the first day class.**

### **Course Withdrawal**

Students should refer to the Refund and Drop/Add Deadlines for the particular term at [onestop.umn.edu](http://onestop.umn.edu) for information and deadlines for withdrawing from a course. As a courtesy, students should notify their instructor and, if applicable, advisor of their intent to withdraw.

Students wishing to withdraw from a course after the noted final deadline for a particular term must contact the School of Public Health Office of Admissions and Student Resources at [sph-ssc@umn.edu](mailto:sph-ssc@umn.edu) for further information.

### **Student Conduct Code**

The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: *Student Conduct Code*. To review the Student Conduct Code, please see: [http://regents.umn.edu/sites/default/files/policies/Student\\_Conduct\\_Code.pdf](http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf).

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities

### **Use of Personal Electronic Devices in the Classroom**

Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference: <http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>.

### **Scholastic Dishonesty**

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: [http://regents.umn.edu/sites/default/files/policies/Student\\_Conduct\\_Code.pdf](http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf)) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html>.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: <http://www1.umn.edu/oscai/integrity/student/index.html>. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

### **Makeup Work for Legitimate Absences**

Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections. For complete information, please see: <http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html>.

### **Appropriate Student Use of Class Notes and Course Materials**

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>.

### **Sexual Harassment**

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy: <http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf>

### **Equity, Diversity, Equal Opportunity, and Affirmative Action**

The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: [http://regents.umn.edu/sites/default/files/policies/Equity\\_Diversity\\_EO\\_AA.pdf](http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf).

### **Disability Accommodations**

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. Disability Services (DS) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 to arrange a confidential discussion regarding equitable access and reasonable accommodations.

If you are registered with DS and have a current letter requesting reasonable accommodations, please contact your instructor as early in the semester as possible to discuss how the accommodations will be applied in the course.

For more information, please see the DS website, <https://diversity.umn.edu/disability/>.

### **Mental Health and Stress Management**

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>.

**The Office of Student Affairs at the University of Minnesota**

The Office for Student Affairs provides services, programs, and facilities that advance student success, inspire students to make life-long positive contributions to society, promote an inclusive environment, and enrich the University of Minnesota community.

Units within the Office for Student Affairs include, the Aurora Center for Advocacy & Education, Boynton Health Service, Central Career Initiatives (CCE, CDes, CFANS), Leadership Education and Development –Undergraduate Programs (LEAD-UP), the Office for Fraternity and Sorority Life, the Office for Student Conduct and Academic Integrity, the Office for Student Engagement, the Parent Program, Recreational Sports, Student and Community Relations, the Student Conflict Resolution Center, the Student Parent HELP Center, Student Unions & Activities, University Counseling & Consulting Services, and University Student Legal Service.

For more information, please see the Office of Student Affairs at <http://www.osa.umn.edu/index.html>.

**Academic Freedom and Responsibility: for courses that do not involve students in research**

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.\*

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

**OR:**

**Academic Freedom and Responsibility, for courses that involve students in research**

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom and conduct relevant research. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.\* When conducting research, pertinent institutional approvals must be obtained and the research must be consistent with University policies.

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

\* Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".