

**PubH 7440**  
**Introduction to Bayesian Analysis**  
**Spring 2018**

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**Credits:** 3  
**Meeting Days:** Tuesday and Thursday  
**Meeting Time:** 1:00 PM – 2:15 PM  
**Meeting Place:** Moos 2-118 (Tuesday), Mayo C381 (Thursday)  
**Instructor:** Lin Zhang, PhD, Bin Guo (TA)  
**Office Address:** A430 Mayo Bldg, MMC 303, 420 Delaware St S.E., Minneapolis MN 55455  
**Office Phone:** 612-624-0624  
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**E-mail:** [zhan4800@umn.edu](mailto:zhan4800@umn.edu); [guoxx617@umn.edu](mailto:guoxx617@umn.edu)  
**Office Hours:** Lin: Thur. 2:30PM-4:30PM, or by appointment;  
Bin: Mon. & Wed. 10:00AM – 11:00PM; held in TA Room Mayo A446.

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**I. Course Description**

This course introduces hierarchical Bayesian statistical methods that enable investigators to combine information from similar experiments, account for complex spatial, temporal, and other correlations, and also incorporate prior information or expert knowledge (when available) into a statistical analysis. The course explains the theory behind Bayesian methods and their practical implementation, and also compares the with classical (frequentist) methods. The course emphasizes data analysis via modern computer software such as R and WinBUGS, which will be introduced and used throughout the course.

**II. Course Prerequisites**

Stat 5101-02, or PubH 7405-06, or instructor's consent. If you are unsure about your qualifications for the course, please contact the instructor.

**III. Course Goals and Objectives**

Upon successful completion, students will be able to independently formulate Bayesian hierarchical models for analyzing complex datasets arising from non-trivial statistical designs and observational data settings. They will be able to implement models using statistical software, and write and give comprehensive oral reports of their analysis.

#### IV. Methods of Instruction and Work Expectations

Through in-class lectures and presentations, and also through hands-on practice. The classroom doesn't have a computer lab. Hence, students are encouraged to bring their own laptop to engage themselves with the flow.

#### V. Course Text and Readings

The only required text for the course is *Bayesian Methods for Data Analysis, 3<sup>rd</sup> edition*, by Bradley P. Carlin and Thomas A. Louis, published by CRC Press/Taylor and Francis group. Other reading materials will be provided as needed on moodle website ([moodle.umn.edu](http://moodle.umn.edu)).

#### VI. Course Outline/Weekly Schedule

Week 1: Preliminaries; Overview of Bayesian inference

Week 2: Basics of Bayesian inference; Introduction to the R computing environment and language;

Week 3: Theory of Bayesian linear models; Bayesian linear models in R

Week 4: Introduction to WinBUGS and hierarchical modeling

Week 5: Bayesian computing; Markov chain Monte Carlo (MCMC) methods; packages in R

Week 6: Bayesian model criticism and selection.

Week 7: Examples; Review.

Week 8: Review by Bin; **In-class MIDTERM 1 on March 8th**

Week 9: Spring break.

Week 10: Empirical Bayes methods: point and interval estimates, frequentist comparisons

Week 11: Bayesian design and analysis of clinical trials

Week 12: Hierarchical longitudinal models; **MIDTERM 2 (take-home)**

Week 13: Bayesian survival analysis and frailty modeling; **Project Selection**

Week 14: More examples; Review; **MIDTERM 2 DUE.**

Week 15: Spatial and spatiotemporal models

Week 16: Bayesian Case Studies; Special Topics; Review and Catch Up

Week 17: **FINAL PROJECT PRESENTATIONS; final write-ups due in Mid May.**

#### VII. Evaluation and Grading

Your final grade will be based upon **homework assignments (40%)**, **two midterms (15 and 15% respectively)**, and **a final project with presentation (30%)**. The following table gives the final grades corresponding to your final score.

A	90+
A-	85-90
B+	80-85
B	75-80
B-	70-75
F	50-

The homework problems will include theoretical and applied questions, mostly from the text. Assignments will be given out as appropriate throughout the semester, and will generally be due one week after they are assigned. Occasionally, I will relax the due date. Students should try to do their own work on these problems; the TA and I are available for questions, of course. The first midterm will be in-class (open-book), while the

second will be take-home. For data analysis homework and midterm problems, your write-up must be a careful report of your models, methods, interpretations, and conclusions something similar to a final report you would like to hand out to a supervisor with statistical training. It should include only the relevant parts of your computer output in your report, labeling all plots, variables, and so forth. You need not get too carried away -- always substitute prose for output where possible.

The final project involves preparing a short (5-10 page) report and giving a brief (15-20 minute) poster presentation on some subtopic of interest to you. **Students may work individually or in group of 2.** If choosing to work in group, group members may assign speaking responsibilities in any way they please, but writing responsibilities should be shared. Members of a group will receive the same final project grade. Once your group has formed and identified a topic of interest, you will need to meet briefly with me to “reserve” your topic. I may suggest a paper or two for you to read, which may in turn suggest several interesting project possibilities: extending an analytical result, simulating the performance of some procedure, undertaking a challenging data analysis, etc. More final project information will be provided as the course unfolds.

I take a very dim view of unexcused late assignments, especially in a class like this where most of the work is ‘take-home’. As a general rule, **prior notification is essential** to my accepting a homework submission, or late paper of any kind. If illness or travel is going to cause you to miss a deadline, please send an e-mail message (both the TA and myself check our e-mails constantly).

**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).

### **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".