PubH 7430-001
Statistical Methods for Correlated Data
Fall 2017

Credits:	3
Meeting Days:	Tuesday and Thursday
Meeting Time:	9:45 a.m. – 11:00 a.m.
Meeting Place:	Moos Health Sci Tower 2-520
Instructor:	Erika Helgeson
Office Address:	2221 University Ave. SE, Room 361
Office Phone:	612-626-1166
E-mail:	helge@umn.edu
Office Hours:	Mayo A454-1: Tuesdays from 11:15 AM - 12:15 PM, or by appointment
TAs:	Nicholas Marka (email: marka007@umn.edu)
Office Hours:	To Be Announced

I.   Course Description

Correlated data arise in many situations, particularly when observations are made over time and space or on individuals who share certain underlying characteristics. In this course, we will study techniques for exploring and describing correlated data, along with statistical methods for estimating population parameters (mostly means) from these data. We will focus primarily on the class of generalized linear models (both with and without random effects) for normally and non-normally distributed data. Wherever possible, techniques will be illustrated using real-world examples. Computing will be done using R and SAS.

PUBH 7430 is a course designed for second year MS students in Biostatistics or Statistics and PhD students in other quantitative fields. There will be a focus on applications, although underlying statistical concepts and theory will be reviewed as necessary.

II.   Course Prerequisites

Statistics: Regression at the level of PubH 6451 (Biostatistics II) or PubH 7405 (Biostatistics Regression) or Stat 5302 (Applied Regression Analysis). Students should be familiar with the basic

notions of random variables, statistical inference (confidence intervals, hypothesis testing), multiple linear regression, and logistic regression.

Linear Algebra: Some familiarity with basic matrix notation and operations (multiplication, inverse, transpose). We will review this VERY briefly towards the beginning of the course. During the semester, the underlying statistical theory will be outlined using matrix notation, but deep understanding of the theory is not necessary for homework or exams.

Computing: Working knowledge of SAS or R at the level of PubH 6420. Other software (e.g., Stata or SPSS) can be used for data analysis but support for these packages cannot be guaranteed from the instructor or teaching assistant.

III. Course Goals and Objectives

Upon completing this course, students should be able to:

- Identify situations where correlated data may arise.

- Describe and summarize correlation in a dataset both graphically and numerically.

- Apply appropriate statistical estimation techniques to answer scientific questions using correlated data.

- Understand both the strengths and limitations of these techniques.

IV. Methods of Instruction and Work Expectations

Students are expected to attend class, participate in class discussions, and complete the assigned homework, exam, and project. Working together on homework assignments is permitted, but **each student is expected to independently write-up homework assignments, using their own computing and in their own words.**

V. Course Text and Readings

There is no required text for this course. However, lecture notes will draw heavily from the first nine chapters of:

Diggle, Heagerty, Liang, and Zeger (2002) Analysis of Longitudinal Data, New York: Oxford University Press. ISBN 0198524846.

This is an excellent text that gives some mathematical theory as well as practical aspects and applications of methods for the analysis of longitudinal data. Many of the technical details it provides are beyond the scope of this course, but you may find it to be a useful reference.

The following books may also be of use:

Fitzmaurice, Laird and Ware (2004) Applied Longitudinal Analysis. John Wiley and Sons.
This text provides an introductory presentation of longitudinal data methods suitable for graduate level work.

Verbeke and Molenberghs (2000). *Linear Mixed Models for Longitudinal Data*, New York: Springer-Verlag, Inc. ISBN 0387950273.

If you expect your future work to involve lots of longitudinal data analysis in SAS, this is a helpful book to own.

The Biostatistics Reading Room (Mayo A-460) has full documentation for SAS, two books on graphing in SAS, and the following:

Littell, Miliken, Stroup, and Wolfinger (1996). *SAS System for Mixed Models*, Cary, NC: SAS Institute, Inc. For detailed examples using SAS `PROC MIXED`.

Khattree and Naik (1999). *Applied Multivariate Statistics with SAS Software*, 2nd Edition, Cary, NC: SAS Institute, Inc. For detailed graphing and modeling examples using SAS.

VI. Course Outline/Weekly Schedule

Tentative schedule of topics:

- Overview and introduction (week 1)
- Exploratory and descriptive analyses, sample size calculations (2-4)
- Generalized linear models (GLMs) for independent data (5)
- Marginal models and generalized estimating equations (6-9)
- Generalized linear mixed models (GLMMs) for correlated data (11-14)
- Special topics (time permitting, 15)

Tentative schedule of activities:

Activity/Assignment	Due Date
Project: Survey	Sept. 8
Assignment 0	Sept. 12
Assignment 1	Sept. 29
Project: Propose topics	Oct. 3
Assignment 2	Oct. 11
Assignment 3	Oct. 25
Midterm	**Nov. 2**
Assignment 4	Nov. 10
Project: Statistical analysis plan	Nov. 17
Assignment 5	Nov. 29
Project: Results	Dec. 4
Project: Poster Presentations	Dec. 12
Project: Final report	Dec. 13
Project: Peer evaluation	Dec. 21

VII. Evaluation and Grading

There will be 5 homework assignments, distributed roughly every two weeks. There will be a midterm exam towards the middle of the term.

Students will also complete a group project. The project grade will be based on clarity of project proposal and quality of statistical analysis plan (20%), final study report/presentation (50%), the quality of your peer evaluation of other projects (15%), and on your active and timely participation in the project (15%), as determined by group member feedback and by the instructor's judgement based on such things as your participation in the discussion of the project presentations.

The final grade will be determined by equally weighting the average homework, midterm, and group project grade:

33% homework (each assignment contributes equally), 33% midterm, and 33% group project

No make-up work will be allowed for missed assignments, projects, or exams.

A letter grade will be determined from the percentage of points each student receives. **The following translation of number grades to letters represents the strictest possible scheme that could be used**; the instructor may make the scheme less strict (e.g., A = 91-100%, B = 86-90%, etc.) depending on the final distribution of numerical grades:

A	93-100%
A-	88-92%
B+	83-89%
B	78-82%
B-	73-77%
C+	69-72%
C	65-68%
C-	62-64%
D+	59-61-%
D	56-58%
F	0-55%

For those enrolled S/N, a letter grade of C or better must be achieved to receive an S. The University Senate has established a uniform grading policy for all letter grades: `http://www.policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPT S.html`. If you would like to switch grading options (e.g., A/F to S/N), it must be done within the first two weeks of the semester.

Course Evaluation
Beginning in fall 2008, the SPH will collect student course evaluations electronically using a software system called CoursEval: www.sph.umn.edu/courseval. 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. 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.

University of Minnesota Uniform Grading and Transcript Policy - A link to the policy can be found at 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.

Course Withdrawal

Students should refer to the Refund and Drop/Add Deadlines for the particular term at 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 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.

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) 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.

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:
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, (Dr Kristin Anderson, SPH Dean of Student Affairs), 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".

Student Academic Success Services (SASS): http://www.sass.umn.edu:
Students who wish to improve their academic performance may find assistance from Student Academic Support Services.   While tutoring and advising are not offered, SASS provides resources such as individual consultations, workshops, and self-help materials.