

PubH 6451: Biostatistics II
Spring 2018
Online Section

Instructor	
Robert Leduc	
Email:	leduc006@umn.edu
Office Hours:	Online, by appointment.

Location: Online
Credits: 4

TA	
Siyu Chen	
E-mail:	chen5165@umn.edu
Alex Knutson	
E-mail:	knuts828@umn.edu

I. Course Description

PubH 6451 is the second semester of an introduction to biostatistics sequence that teaches statistical methods applied in the health sciences. This course covers a broad range of methods, with a focus on their practical use and interpretation in clinical trials and observational studies.

The methods covered include:

- A review of *t*-tests, linear regression, and ANOVA for continuous outcomes;
- Relative risk, odds ratios, logistic regression, and Poisson regression for categorical outcomes;
- Survival data, Kaplan-Meier tables and curves, and proportional hazards regression for time-to-event outcomes; and,
- Sample size estimation and power considerations.

Computations are illustrated in SAS and R. This course is offered online via Moodle.

II. Course Prerequisites

PubH 6450 with grade of at least B & health sciences graduate student, or instructor consent.

III. Course Goals and Objectives

At the conclusion of the course, students should be able to compare study groups based on outcome measures that are continuous, binary, or time-to-event while adjusting for one or more variables. Students

will use SAS or R to apply each method and should be able to understand the output produced by SAS or R.

Specifically, students should be able to:

- Determine the appropriate test to use based on how the data were collected and on the outcome variable of interest, and be able to interpret results from that test.
- Use a statistical software tool (SAS or R) to analyze data including:
 - Hypothesis Testing for Means
 - ANOVA (One and Two-way)
 - Simple and Multiple Linear Regression
 - Logistic Regression
 - Poisson Regression
 - Survival Analysis, including Proportional Hazards Analysis
 - Sample Size Estimation and Power Considerations

IV. Methods of Instruction and Work Expectations

Course Organization:

The course is organized by seven sections. For each section, there are:

- Online lecture slide sets and, if any, supplemental text readings.
- Software lesson videos for learning how to use a statistical software (SAS or R).
- Problem sets (to be worked on as a class via a collaborative key).
- End-of-Section quiz.

You are encouraged to work together on the problem sets. However, the end-of-section quizzes **MUST** be taken individually. Evidence of collaboration or cheating on the quizzes will not be tolerated and will be referred to the University for the disciplinary process.

In addition to problem sets and quizzes, there are also two programming activities. You **must work alone** on these **except** where the instructors specifically note collaboration is acceptable. Evidence of collaboration where not permitted will be referred to the University for the disciplinary process.

NOTE: The online section is not self-paced. This course covers a large amount of material (i.e., statistical topics and SAS or R programming) in a short time. Therefore **late assignments or quizzes will not be accepted.**

Computing:

The course includes examples of data analysis from SAS and R. You will need access to SAS or R to complete your assignments.

SAS or R is available around campus.

To decide on what software to use and how to obtain it, review this guide:

https://docs.google.com/document/d/1JTeRjUAg-0PT1NZKiQUaMuFDx7pHeQFy6QHKH5ox_s/edit#heading=h.u861d734fex9

Course Communication:

You **MUST** use your **University of Minnesota email address** (X.500 address) for email. All course communication will be sent to your email account. If you have not yet initiated your U of M email account, you will need to do so at <http://www.umn.edu/initiate>.

V. Course Text and Readings

There is no required textbook for this course.

Optional books:

- *Introduction to the Practice of Statistics, (6th ed.)*, by D. Moore, G. McCabe, and B. Craig. W.H. Freeman. ISBN 978-1-4292-1622-7.
- *OpenIntro Statistics, (3rd ed.)*, by D. Diez, C. Barr, and M. Çetinkaya-Rundel. Openintro.org. https://www.openintro.org/stat/textbook.php?stat_book=os (A freely available e-textbook in pdf format)
- *Primer of Biostatistics* by S. Glantz. McGraw-Hill Medical. ISBN 978-0071781503. (A freely accessible e-book is available via the University of Minnesota (UMN) Libraries website)
- *Basic & Clinical Biostatistics (4th ed)* by B. Dawson and R. Trapp. Lange Medical Books/McGraw-Hill. ISBN 978- 0071410175. (A freely accessible e-book is available via the UMN Libraries website)
- *Essentials of Medical Statistics, (2nd ed)* by B. Kirkwood and J. Sterne. Wiley-Blackwell. ISBN 978-0865428713.
- *Statistical Modeling for Biomedical Researchers: A Simple Introduction to the Analysis of Complex Data* by W. Dupont. Cambridge University Press. ISBN 978-0521614801. (uses STATA) (A freely accessible e-book is available via the UMN Libraries website)
- *Regression Methods in Biostatistics: Linear, Logistic, Survival, and Repeated Measures Models* by E. Vittinghoff, D. Glidden, S. Shiboski, and C. McCulloch. Springer. ISBN 978-1441919052. (more mathematical, uses STATA) (A freely accessible e-book is available via the UMN Libraries website)
- *The Little SAS Book*, by L. Delwiche & S. Slaughter, SAS Institute. ISBN 978-1599947259. (An older edition is available as a freely accessible e-book through the UMN Libraries website)
- *Logistic Regression Using the SAS System: Theory and Application* by P. Allison. Wiley-SAS. ISBN 978-0471221753. (A freely accessible e-book is available via the UMN Libraries website)
- *Modeling Survival Data in Medical Research* by D. Collett. Chapman and Hall/CRC. ISBN 978-1584883258.
- *Applied Statistics and SAS Programming Language*, by R. Cody & J. Smith. Prentice-Hall Inc. ISBN 978-0131465329.
- *A Handbook of Statistical Analyses Using R*, by B. S. Everitt and T. Hothorn. Chapman & Hall/CRC. ISBN 978-1-4200-7933-3. (Also a freely accessible e-book is available via the UMN Libraries website)
- *SAS and R: Data Management, Statistical Analysis, and Graphics*, by K. Kleinman and Nicholas J. Horton. Chapman & Hall/CRC. ISBN 978-1-4200-7057-6. (A freely accessible e-book is available via the UMN Libraries website)

Recommended statistical software resources:

SAS tutorials at UCLA: <http://www.ats.ucla.edu/stat/sas/>

R tutorials at UCLA: <http://www.ats.ucla.edu/stat/r/>

Introduction to R: <http://cran.r-project.org/doc/manuals/R-intro.pdf>

VI. Course Outline/Weekly Schedule

Weeks	Dates (Mon– Sun)	Topics & Assignments
Section 0: Review Hypothesis Testing for Means, One-Way ANOVA		
1	Jan 16-21	<p><i>Review Lessons</i></p> <ul style="list-style-type: none"> • Install and test SAS or R on your computer! • Lesson 1a: Hypothesis Testing for One Mean • Lesson 1b: Hypothesis Testing for Matched Pairs Design • Lesson 1c: Hypothesis Testing for Two Independent Means • Lesson 1d: Hypothesis Test for Comparing Means from Two or More Independent Populations <p><i>Assignments</i></p> <ul style="list-style-type: none"> • Problem Set #0 due Sunday Jan. 21 at 11: 55 (CST) • Quiz #0 due Sunday, Jan. 21 at 11:55pm (CST)
Section 1: Analysis of Variance		
2-3	Jan. 23 – Feb. 4	<p><i>Lessons</i></p> <ul style="list-style-type: none"> • Lesson 1e: Two-Way ANOVA • Lesson 1f: Adjustment by Stratification, Adjusted Means and Main Effects <p><i>Assignments</i></p> <ul style="list-style-type: none"> • Problem Set #1 due Friday, Feb. 2 at 11:55pm (CST) • Quiz #1 due Sunday, Feb. 4 at 11:55pm (CST)
Section 2: Linear Regression		
4	Feb. 5 – 11	<p><i>Lessons</i></p> <ul style="list-style-type: none"> • Lesson 2a: Scatter Plots and Correlation • Lesson 2b: Least Squares Regression • Lesson 2c: Regression Diagnostics • Lesson 2d: More Regression Diagnostics and Confidence Intervals • Lesson 2e: The ANOVA Table for Regression <p><i>Assignments</i></p> <ul style="list-style-type: none"> • Problem Set #2 due Friday, Feb. 9 at 11:55pm (CST) • Quiz #2 due Sunday, Feb. 11 at 11:55pm (CST)
Section 3: Multiple Linear Regression		
5-6	Feb. 12 – 25	<p><i>Lessons</i></p> <ul style="list-style-type: none"> • Lesson 3a: Multiple Regression Introduction • Lesson 3b: Multiple Regression with Interaction and Diagnostics • Lesson 3c: Case Study <p><i>Assignments</i></p> <ul style="list-style-type: none"> • Problem Set #3 due Friday, Feb. 23 at 11:55pm (CST) • Quiz #3 due Sunday, Feb. 25 at 11:55pm (CST)

Section 4: Sample Size Estimation		
7	Feb. 26 – Mar. 4	<p><i>Lesson</i></p> <ul style="list-style-type: none"> Lesson 4a: Introduction to Sample Size and Power <p><i>Assignments</i></p> <ul style="list-style-type: none"> Problem Set #4 due Friday, Mar. 2 at 11:55pm (CST) Quiz #4 due Sunday, Mar. 4 at 11:55pm (CST)
Programming Activity		
8	Mar. 4 – 11	<ul style="list-style-type: none"> Programming Activity #1 due Sunday, Mar. 11 at 11:55pm (CST) Covers Sections 1-3
Section 5: Logistic Regression		
9-10	(Spring Break Mar. 12-16) Mar. 19 – Apr. 1	<p><i>Lessons</i></p> <ul style="list-style-type: none"> Lesson 5a: Logistic Regression Introduction Lesson 5b: Logistic Regression with Interactions Lesson 5c: Diagnostics and ROC Curves in Logistic Regression <p><i>Assignments</i></p> <ul style="list-style-type: none"> Problem Set #5 due Friday, Mar. 30 at 11:55pm (CST) Quiz #5 due Sunday, Apr. 1 at 11:55pm (CST)
Section 6: Survival Data		
11-12	Apr. 2 – 15	<p><i>Lessons</i></p> <ul style="list-style-type: none"> Lesson 6a: Estimating Survival Curves Lesson 6b: Comparing Survival Curves Lesson 6c: Important Concepts in Survival Analysis Lesson 6d: Cox Proportional Hazards Model: Introduction Lesson 6e: Cox Proportional Hazards Model with Interactions; Testing Proportionality <p><i>Assignments</i></p> <ul style="list-style-type: none"> Problem Set #6 due Friday, Apr. 13 at 11:55pm (CST) Quiz #6 due Sunday, Apr. 15 at 11:55pm (CST)
Section 7: Poisson Regression		
13	Apr. 16 – 22	<p><i>Lessons</i></p> <ul style="list-style-type: none"> Lesson 7a: Poisson Regression Introduction <p><i>Assignments</i></p> <ul style="list-style-type: none"> Problem Set #7 due Friday, Apr. 20 at 11:55pm (CST) Quiz #7 due Sunday, Apr. 22 at 11:55pm (CST)
Programming Activity		
14-15	Apr. 23 – May 4	<ul style="list-style-type: none"> Programming Activity #2 due FRIDAY, May 4 at 11:55pm (CST) Covers Sections 5-7

VII. Evaluation and Grading

The final grade is based on:

- Eight quizzes (50% total)
- Two programming activities (30% total)
 - Programming Activity #1 (10%)
 - Programming Activity #2 (20%)
- Active and timely participation in the problem sets by contributing to the collaborative answer keys (20%).

Late Policy: This course covers a large amount of material in a short time. Therefore **late assignments or quizzes will not be accepted.**

Academic Integrity Policy: I expect that students will complete all end-of-section quizzes **INDEPENDENTLY**, without assistance from any other people. If I have any reason to suspect that a student gave assistance on an end-of-section quiz to another student or received assistance on an end-of-section quiz from another student or a person outside the class, all students involved will receive a score of zero on that quiz. If I believe that scholastic dishonesty has occurred, I am required by the University to report the incident to the Office of Community Standards

The A/F letter grade will be determined by total effort as follows:

The University utilizes plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following:

A	4.000 - Represents achievement that is outstanding relative to the level necessary to meet course requirements
A-	3.667
B+	3.333
B	3.000 - Represents achievement that is significantly above the level necessary to meet course requirements
B-	2.667
C+	2.333
C	2.000 - Represents achievement that meets the course requirements in every respect
C-	1.667
D+	1.333
D	1.000 - Represents achievement that is worthy of credit even though it fails to meet fully the course requirements
S	Represents achievement that is satisfactory, which is equivalent to a C- or better.

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 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. The Disability Resource Center Student Services 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 DRC at 612-626-1333 or drc@umn.edu 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. 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, (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.

Template update 9/2014 [sic – download from isph.umn.edu 12/23/2017]