PubH 6451: Biostatistics II

Spring 2017

Online Section

Instructors			
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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.

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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:

  o Hypothesis Testing for Means

  o ANOVA (One and Two-way)

  o Simple and Multiple Linear Regression

  o Logistic Regression

  o Poisson Regression

  o Survival Analysis, including Proportional Hazards Analysis

  o Sample Size Estimation and Power Considerations

IV. Methods of Instruction and Work Expectations

Course Organization:

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

- Online lecture slide sets (including a video) and 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 in computing and discussing 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.

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 <u>not</u> 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.

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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-
0PT1NZKiQUDaMuFDx7pHeQFy6QHKH5ox_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.

- *Primer of Biostatistics* by S. Glantz. McGraw-Hill Medical. ISBN 978-0071781503. **(A freely accessible e-book is available via the University of Minnesota 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 University of Minnesota 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 University of Minnesota 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 University of Minnesota Libraries website)**

- *The Little SAS Book*, by L. Delwiche & S. Slaughter, SAS Institute. ISBN 978-1599947259.

- *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 University of Minnesota 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.

- *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 University of Minnesota 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

Week	Dates (Mon– Sun)	Topics & Assignments
Section 1: Hypothesis Testing for Means		
1–3	Jan. 17 – Feb. 5	*Lesson Week 1* • Install and test SAS or R on your computer! *Assignments* • **Quiz #0 due Sunday, Jan. 22 at 11:55pm (CST)** *Lessons* • 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 Testing for Two or More Independent Means (ANOVA) • Lesson 1e: Two-Way ANOVA *Assignments* • **Problem set #1 due Wednesday, Feb. 1 at 11:55pm (CST)** • **Quiz #1 due Sunday, Feb. 5 at 11:55pm (CST)**
Section 2: Linear Regression		
4–5	Feb 6 - 19	*Lessons* • Lesson 2a: Scatter Plots and Correlation • Lesson 2b: Linear Regression • Lesson 2c: Linear Regression Diagnostics–Plots • Lesson 2d: Linear Regression Diagnostics–Influential and Outliers • Lesson 2e: Calculations in the ANOVA table *Assignments* • **Problem set #2 due Wednesday, Feb. 15 at 11:55pm (CST)** • **Quiz #2 due Sunday, Feb. 19 at 11:55pm (CST)**
Section 3: Multiple Linear Regression		
6	Feb 20 - 26	*Lessons* • Lesson 3a: Multiple Linear Regression without Interaction • Lesson 3b: Multiple Linear Regression with Interaction • Lesson 3c: ANOVA vs. ANCOVA vs. Regression and Adjusted Means Comparisons *Assignments* • **Problem set #3 due Wednesday, Feb. 22 at 11:55pm (CST)** • **Quiz #3 due Sunday, Feb. 26 at 11:55pm (CST)**
Section 4: Sample Size Estimation		
7	Feb 27 - Mar 5	*Lesson* • Lesson 4a: General Understanding of Sample Size and Power *Assignments* • **Problem set #4 due Wednesday, Mar. 1 at 11:55pm (CST)** • **Quiz #4 due Sunday, Mar. 5 at 11:55pm (CST)**

Programming Activity		
8	Mar 6 - 11	• **Programming Activity #1 due <mark>SATURDAY, Mar. 11 at 12:05pm</mark> (CST)** Covers Sections 1-3
	Mar 12 - 19	SPRING BREAK
Section 5: Logistic Regression		
9-10	Mar 20 – Apr 2	*Lessons* • Lesson 5a: Introduction to Logistic Regression • Lesson 5b: Calculating probabilities and Considering Interaction Terms • Lesson 5c: ROC Curves in Logistic Regression *Assignments* • **Problem set #5 due Wednesday, Mar. 29 at 11:55pm (CST)** • **Quiz #5 due Sunday, Apr. 2 at 11:55pm (CST)**
Section 6: Survival Data		
11	Apr 3 - 9	*Lessons* • Lesson 6a: Introduction to Survival Data • Lesson 6b: Kaplan Meier Estimates, Comparing Survival Curves
Section 7: Survival Analysis		
12	Apr 10 - 16	*Lessons* • Lesson 7a: Introduction to Survival Analysis–Cox Proportional Hazards • Lesson 7b: Interaction Terms and Testing Model Assumptions *Assignments* • **Problem set #6 due Wednesday, Apr. 12 at 11:55pm (CST)** • **Quiz #6 due Sunday, Apr. 16 at 11:55pm (CST)**
Section 8: Poisson Regression		
13	Apr 17 - 23	*Lessons* • Lesson 8a: Introduction to Poisson Regression • Lesson 8b: Interaction Terms and Testing Model Assumptions *Assignments* • **Problem set #7 due Wednesday, Apr. 19 at 11:55pm (CST)** • **Quiz #7 due Sunday, Apr. 23 at 11:55pm (CST)**
Programming Activity		
14-15	Apr 24 – May 7	• **Programming Activity #2 due <mark>WEDNESDAY, May 3</mark> at 11:55pm (CST)** Covers Sections 5-8

VII. Evaluation and Grading

The final grade is based on:

- Eight quizzes (lowest 1 dropped) (50%)

- Two programming activities (30% total)

   - Programming Activity #1 (10%)

   - Programming Activity #2 (20%)

- Active and timely participation in class 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 a quiz to another student or received assistance on a quiz from another student or a person outside the class, I will file a claim with the Office of Student Conduct and Academic Integrity.

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

Highest	Lowest	Letter
100.00 %	93.00 %	A
92.99 %	90.00 %	A-
89.99 %	87.00 %	B+
86.99 %	83.00 %	B
82.99 %	80.00 %	B-
79.99 %	77.00 %	C+
76.99 %	73.00 %	C
72.99 %	70.00 %	C-
69.99 %	67.00 %	D+
66.99 %	60.00 %	D
59.99 %	0.00 %	F

For additional information, please refer to:
http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html.

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."

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.

Academic Freedom and Responsibility: *for courses that do <u>not</u> 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. *[Customize with names and contact information as appropriate for the course/college/campus.]*

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

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