The Ohio State University College of Public Health
PUBHBIO 7235 – Applied Survival Analysis
3 credit hours – Spring 2017

Instructor: Michael Pennell, Ph.D.
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Office Hours: Tuesday & Thursday after class until 3 pm, Cunz 246

Class Time: Tuesday & Thursday 12:45-2:05pm, Jennings 136

Teaching Assistant: Sara Conroy, conroy.55@buckeyemail.osu.edu, Office Hours: Wednesdays 11 am
                      – 12 pm, Cunz 230

TA responsibilities: The TA assigned to the course will hold regular office hours and lead review sessions for any students who need help with class material. The TA may assist with scoring homework and exams; however, final grades will be assigned by the professor. Any questions regarding grading should be directed to the professor and not the TA.

Course Description: An introduction to time-to-event data analysis. The primary focus will be how to analyze such data using methods available in standard statistical software packages. Topics include estimation of summary statistics, non-parametric methods, semiparametric models, parametric models, and competing risks analysis. The course will include analyzing real health science data using statistical software.

Prerequisites: PUBHBIO 6212 (PUBHBIO 703), Stat 6450 (645) or 6950, or permission of the instructor. Not open to students with credit for Stat 6605 (BioStat 605).

Class format: The course materials will be delivered through classroom lecturing.

Class Policies: The class will move quickly and cover a substantial amount of material; thus, attendance at each class is expected. Please read the relevant material in the textbook before each lecture. Homework and exams will be returned during the regular class time. It is the student's responsibility to show up for every class and pick up graded homework and exams.

Carmen site: Login at http://carmen.osu.edu. The site contains the syllabus, lecture notes, homework assignments and solutions, and course announcements.

Primary Text:

Applied Survival Analysis, 2nd edition, by Hosmer, Lemeshow and May (2008). Available online (for free) at: http://proquest.safaribooksonline.com/9781118211588
You must access the book online using a university computer or be logged-in to the library website if accessing remotely.

Secondary Texts:

Regression Methods in Biostatistics, by Vittinghoff, Glidden, Shiboski and McCulloch (2012). Available free online at: http://link.springer.com/book/10.1007/978-1-4614-1353-0.

Survival Analysis: Techniques for Censored and Truncated Data, 2nd edition, by Klein & Moeschberger (2003). Available free online at:
http://web.a.ebscohost.com/ehost/detail/detail?sid=03573274-452a-4fe0-8f87-
f8b34f3b285e%40sessionmgr4002&vid=0&hid=4204&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#A
N=108043&db=nlebk

Survival Analysis: A Self-Learning Text, by Kleinbaum and Klein (2005). Available free online at:
http://link.springer.com.proxy.lib.ohio-state.edu/book/10.1007%2F0-387-29150-4

Required Software: STATA (http://www.stata.com/). STATA is available free of charge on the PCs in Cunz Hall computer labs (rooms 230 and 330). Students may choose to use other software packages, but examples will only be provided in STATA.

Course Objectives:
Upon successful completion of the course, students will be able to:

1. Identify characteristics of time-to-event data that distinguishes it from other types of measurements and how this impacts the analytical methods.
2. Estimate summary measures for data in the presence of censoring and truncation.
3. Obtain and interpret Kaplan-Meier and Nelson-Aalen estimators.
4. Conduct and interpret nonparametric tests for comparing survival curves.
5. Fit, using statistical software, semi-parametric and parametric models for survival data and interpret the output.
6. Apply appropriate model building techniques to select and assess the fit of parametric and semi-parametric models for time-to-event data.
7. Implement methods appropriate for survival data subject to non-proportional hazards, left truncation, interval censoring, and competing risks.

Core Competencies Covered:

- **Core MPH Competencies:**

1. Apply appropriate descriptive and inferential statistical techniques to public health data and interpret results of statistical analyses in the context of public health research and evaluation.
3. Apply epidemiologic principles to investigate the distribution of risk factors and disease in the population to improve public health.
6. Demonstrate effective written and oral skills for communicating with different audiences in the context of professional public health activities.

- **Core MPH in Biostatistics Competencies:**

1. Critique scientific research articles and assess the appropriateness of statistical applications involved.
2. Describe preferred methodological alternatives to commonly used statistical methods when assumptions are not met.

3. Develop written and oral presentations based on statistical analyses for both public health professionals and educated lay audiences
4. Apply appropriate statistical techniques for analyzing public health-related data with specific characteristics.
6. Describe basic concepts of probability, random variation and commonly used statistical probability distributions.
7. Use standard statistical software for both data management and data analysis

- **Core MS Competencies:**

8. Read the scientific literature in the student's field and critique the methods and results.

Grading:

Final class grade will be determined as follows:

        Homework   20%
        Midterm Exams   50% (25% each)
        Final Project   30%

        Grading Scale:*
        94 to 100: A   90 to < 94: A-
        87 to < 90: B+   84 to < 87: B   80 to < 84: B-
        77 to < 80 C+   74 to < 77: C   70 to < 74: C-
        60 to < 70 D   < 60: E

        * The instructor reserves the right to adjust the grading scale if it appears necessary due to overall class performance. These adjustments will only raise a student grade, not lower it.

Midterm Exams:

There will be 2 in-class, closed book and closed notes Midterm Exams. You are allowed to bring ONE letter-size sheet of notes (both sides) to the first exam and TWO letter-size sheets of notes (both sides) to the second exam. **There will be no Final Exam in this class.**

Because exams are returned to students as quickly as possible, it is not possible for any student to take an exam late. Students who miss taking any exam will be penalized fully in the absence of a documented excuse. Similarly, the final exam must be taken at the time scheduled. Students with a problem taking an exam at the scheduled time must contact the instructor immediately upon discovery of the problem.

Homework:

There will be 5 homework assignments. Homework will include both hand-calculation and computer exercises. Late homework will not be accepted. You are permitted (indeed encouraged) to work together on homework, but **submitted assignments must be written independently**. Homework must be submitted in hard copy form to the instructor or his mailbox (Cunz 380) by 5:00 pm the day it is due. Emailed homework will not be accepted unless arranged in advance.

Clear and effective communication is crucial in statistical practice. This rule is applied to both homework

and exams. In any problem solving question it is the student's responsibility to make sure that he/she justifies his/her answer and provides enough detail for the grader to understand. Points will be deducted for answers that are not well-justified.

Final Project:

Thirty percent of your grade will be determined by your performance on an applied data analysis project you will complete in groups assigned by the instructor. Your grade for the project will be based on an oral presentation given during the last two class sessions and a final paper. Instructions and guidelines for the project will be distributed within the first two weeks of the semester.

Office of Student Life: Disability Services

Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office of Student Life: Disability Services at 614-292-3307 in Room 098 Baker Hall 113 W. 12th Ave. to coordinate reasonable accommodations for students with documented disabilities (http://www.ods.ohio-state.edu/).

Mental Health Services

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 or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-- 292--5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614--292--5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-- 800--273--TALK or at suicidepreventionlifeline.org.

Academic integrity

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University's *Code of Student Conduct* and the School's *Student Handbook*, and that all students will complete all academic and scholarly assignments with fairness and honesty. The *Code of Student Conduct* and other information on academic integrity and academic misconduct can be found at the COAM web pages (http://oaa.osu.edu/coam/home.html). Students must recognize that failure to follow the rules and guidelines established in the University's *Code of Student Conduct*, the *Student Handbook*, and in the syllabi for their courses may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the University, or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Please note that the use of material from the Internet

without appropriate acknowledgement and complete citation is plagiarism just as it would be if the source were printed material. Further examples are found in the *Student Handbook*. Ignorance of the *Code of Student Conduct* and the *Student Handbook* is never considered an "excuse" for academic misconduct.

If I suspect a student of academic misconduct in a course, I am obligated by University Rules to report these suspicions to the University's Committee on Academic Misconduct. If COAM determines that the student has violated the University's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in the course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Tentative Schedule:

Block	Lectures	Dates	Topics	Readings*	Homework
I	1	1/10, 1/12	INTRODUCTION 1. Time-to-event data 2. Censoring/truncation 3. Univariable descriptive statistics	Ch 1-2	
II	2-5	1/17-1/24	NON-PARAMETRIC METHODS 1. Kaplan-Meier 2. Key survival quantities 3. Comparisons/tests 4. Other approaches (Nelson-Aalen)	Ch 2	HW1 due Tues, 1/31
III	6-7	1/26, 1/31	INTRO TO REGRESSION MODELS 1. Hazard function 2. Semi-parametric models 3. Fitting the Cox model (partial likelihood) 4. Testing 5. Estimating survival functions	Ch 3	
IV	8-9	2/2, 2/7	COX MODEL INTERPRETATION 1. Continuous and Categorical Predictors 2. Confounding/interactions	Ch 4	HW 2 due Thurs, 2/9
V	10-11	2/9, 2/14	MODEL ASSESSMENT 1. Residuals 2. Proportional hazard assumption 3. Subject level diagnostics 4. Goodness-of-fit	Ch 6	
VI	12-13	2/16, 2/21	MODEL EXTENSIONS, PART I 1. Stratified model 2. Time-varying covariates	Ch 7.1-7.3 Vittinghoff, Ch 6.3	HW 3 due Thurs, 2/23

Block	Lectures	Dates	Topics	Readings*	Homework
	14	2/23	EXAM 1 REVIEW		
	15	2/28	EXAM 1		
VII	16-17	3/2, 3/7	MODEL DEVELOPMENT 1. Randomized Trial 2. Observational Study a.) Studies of a single predictor b.) Identifying predictors c.) Building a predictive model	Vittinghoff, Ch 10	
VIII	18-19	3/9, 3/21**	MODEL EXTENSIONS, PART II 1. Truncated Data 2. Left Censored Data 3. Interval Censored Data	Ch 7.4	HW 4 Due Thurs, 3/23
IX	20-21	3/23, 3/28	COMPETING RISKS ANALYSIS 1. Cumulative Incidence Function 2. Gray's Test 3. Cause-Specific Hazard Model 4. Fine-Gray Model	Ch 9.6, Vittinghoff Ch 6.5, Andersen[†]	
X	22-23	3/30, 4/4	PARAMETRIC MODELS 1. Exponential 2. Weibull 3. Log-logistic	Ch 8	HW 5 Due Thurs, 4/6
XI	24	4/6	SAMPLE SIZE AND POWER (+ Overview of Oral Presentations)	Ch 9.7	
	25	4/11	OVERVIEW OF FINAL PAPERS & EXAM 2 REVIEW		
	26	4/13	EXAM 2		
	27-28	4/18, 4/20	FINAL PROJECT PRESENTATIONS		
		4/24	**FINAL PAPER DUE BY 11:59 PM**		

*Readings are from Hosmer, Lemeshow & May unless stated otherwise
**No class on 3/14 and 3/16 for Spring Break
[†]Andersen et al. (2011). Competing risks in epidemiology: possibilities and pitfalls. *International Journal of Epidemiology* Vol 41, pp. 861-870. Available online: http://ije.oxfordjournals.org/content/41/3/861