SYLLABUS
BIOS 686: Survival Analysis
Spring 2019

Time: Monday 2:00 -3:15 PM
Location: Drachman Hall A119

Instructor:
Paul Hsu, Ph.D.
Office: Drachman A232
Phone: 626-5054
Office Hours: Wednesday 1:00-2:00PM, Appointment Recommended
Email: pchhsu@email.arizona.edu

Course Description:
This course introduces basic concepts and methods for analyzing survival time data obtained from following individuals until occurrence of an event or their loss to follow-up. We will begin this course from describing the characteristics of survival (time to event) data and building the link between distribution, survival, and hazard functions. After that, we will cover non-parametric, semi-parametric, and parametric models and two-sample test techniques. In addition, we will also demonstrate mathematical and graphical methods for evaluating goodness of fit and introduce the concept of dependent censoring/competing risk. During the class, students will also learn how to use SAS to analyze survival data.

Course Prerequisites:
CPH 576A Biostatistics for Public Health; CPH 576B Biostatistics for Research

Course Objectives:
Students completing this course should be able to:
1. Recognize the characteristics of survival data, e.g. censoring and truncation.
2. Determine the proper method to be used in analyzing time-to-event data (e.g., parametric, semi-parametric or non-parametric method).
3. Understand the assumptions for the method chosen to analyze the data.
4. Apply mathematical and graphical methods to check goodness of fit.
5. Perform survival analysis using a computer statistical software package.
6. Interpret computer outputs.
7. Assess the quality of survival analysis conducted in published research papers.

Biostatistics Competencies:
MPH
1. Ability to select appropriate research designs to meet the needs of various studies, and be able to explain the limitations of implemented designs.
2. Ability to identify appropriate statistical tools to address specific scientific questions.
3. Demonstrate excellent presentation skills and the ability to explain statistical concepts and findings to a general scientific audience.
4. Demonstrate skills in data management to handle a variety of practical problems in data format and structure.

5. Demonstrate advanced working skills in application of computer systems and appropriate statistical software.

**MS**

1. Demonstrate understanding of basic concepts of probability, random variation and commonly used statistical probability distributions.

2. Demonstrate the ability to skillfully engage in statistical collaboration with mentors, colleagues, and clients.

3. Recognize strengths and weaknesses of proposed statistical approaches, including alternative designs, data sources, and analytical methods.

4. Suggest preferred methodological alternatives to commonly used statistical methods when assumptions are not met.

5. Demonstrate advanced competencies in areas of professional expertise and scholarship enabling advancement to further postgraduate study in statistics or biostatistics.

**PhD**

1. Apply descriptive and inferential methodologies according to the type of study design for answering a particular research question.

2. Communicate understanding of the assumptions necessary for a given statistical procedure as well as the ability to determine if the assumptions are met for a given study design or data set.

3. Demonstrate the ability to identify, articulate and implement sound study design, methodological and computational strategies for addressing scientific questions.

4. Demonstrate the ability to communicate effectively in writing reports, giving oral presentations, and teaching basic statistical material in a formal classroom or seminar setting.

5. Demonstrate the use of statistical theory necessary for the development and study of new statistical methods or to adapt existing methods to new or unique problems.

**Course Notes:**
Handouts will be uploaded to the course D2L site prior to the lecture.

**Required Text:**
Survival Analysis – Techniques for Censored and Truncated Data, John P. Klein and Melvin L. Moeschberger (KM), Springer.

**References:**
- Those who want to analyze survival data with SAS will find just what they need with this easy-to-read and comprehensive guide. Written for the reader with a modest statistical background and minimal knowledge of SAS software, this book teaches many aspects of data input and manipulation, as well.

Survival Analysis: A Self-Learning Text, David G. Kleinbaum and Mitchel Klein
• An excellent tutorial on survival analysis, including Cox proportional hazards models.

**Course Requirements:**
Successful completion of all homework assignments, one final project and two examinations (midterm and final), and active class participation.

**Grading/Student Evaluation:**
Homework assignments will be from the text, and readings and problems provided by the instructor. Due dates will be given for each assignment. Late homework will not be accepted.

On both homework and examinations, partial credit will be given, so always show your work and be as neat and clear as possible. Grades will be assigned as follows (tentative plans):

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
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<tr>
<td>Midterm Exam</td>
<td>20%</td>
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<tr>
<td>Final Project</td>
<td>45% (10% peer review; 10% presentation; 25% final report)</td>
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<tr>
<td>Participation</td>
<td>5% (participate in class discussions in class or on-line)</td>
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Final grades are based on the following point system:

- A = 90 - 100%
- B = 80 - 89%
- C = 70 - 79%
- D = 60 - 69%
- E = 59% or less

**Announcements:**
A D2L course site will be created for this course. All course announcements will be posted on the site. So check out the course site constantly! In addition, a list of students taking this course can be found on the course site. Students can use the list to find their study partners and exchange experience.

**Class Attendance/Participation:**
I am not going to keep track of attendance, but you are responsible for everything that goes on in class, including any alteration to the syllabus. If I make an announcement in class, you are responsible for it (I do, however, try to remember to confirm important announcements by email). I strongly encourage you to develop a "buddy system" with one or more other students to take notes and announcements down if, for some unavoidable reason, you are unable to make it to class on a particular day. I will try to be in class about 15 minutes early and stay 15 minutes late to handle questions.

**Communications:** You are responsible for reading emails sent to your UA account from your professor and the announcements that are placed on the course website. Information about readings, news events, your grades, assignments and other course related topics will be communicated to you with these electronic methods. The official policy can be found at: [http://www.registrar.arizona.edu/emailpolicy.htm](http://www.registrar.arizona.edu/emailpolicy.htm)

**Disability Accommodation:** If you anticipate issues related to the format or requirements of this course, please meet with me. I would like us to discuss ways to ensure your full participation in the course. If you determine that formal, disability-related accommodations are necessary, it is very important that you be registered with Disability Resources (621-3268; drc.arizona.edu) and notify me of your eligibility for reasonable accommodations. We can then plan how best to
coordinate your accommodations. The official policy can be found at: http://catalog.arizona.edu/2008%2D09/policies/disability.htm

**Academic Integrity:**
Students are expected to abide by the University of Arizona Code of Academic Integrity found at http://deanofstudents.arizona.edu/sites/default/files/code_of_academic_integrity.pdf.

**Classroom Behavior:** (Statement of expected behavior and respectful exchange of ideas)
Students are expected to be familiar with the UA Policy on Disruptive Behavior in an Instructional Setting found at http://web.arizona.edu/~policy/disruptive.pdf and the Policy on Threatening Behavior by Students found at http://web.arizona.edu/~policy/threatening.pdf.

**Grievance Policy:**
Should a student feel he or she has been treated unfairly, there are a number of resources available. With few exceptions, students should first attempt to resolve difficulties informally by bringing those concerns directly to the person responsible for the action, or with the student's graduate advisor, Assistant Dean for Student and Alumni Affairs, department head, or the immediate supervisor of the person responsible for the action. If the problem cannot be resolved informally, the student may file a formal grievance using the Graduate College Grievance Policy found at http://grad.arizona.edu/academics/policies/academic-policies/grievance-policy

**Grade Appeal Policy:**
http://catalog.arizona.edu/2008%2D09/policies/gradappeal.htm

**Syllabus Changes:**
Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate.

**Telephone Use:**
Turn your cell phones to silent or vibrate in order to not disrupt the class and disturb your fellow students and professor.
SCHEDULE:
Any changes to the following schedule will be announced in lecture. You are responsible for obtaining information on any changes, even if you miss class.

Plagiarism:
What counts as plagiarism?
- Copying and pasting information from a web site or another source, and then revising it so that it sounds like your original idea.
- Doing an assignment/essay/take home test with a friend and then handing in separate assignments that contain the same ideas, language, phrases, etc.
- Quoting a passage without quotation marks or citations, so that it looks like your own.
- Paraphrasing a passage without citing it, so that it looks like your own.
- Hiring another person to do your work for you, or purchasing a paper through any of the on- or off-line sources.

Lecture schedule (subject to change)

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<thead>
<tr>
<th>Date</th>
<th>Topic/Lessons</th>
<th>Reading and Assignment</th>
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<tbody>
<tr>
<td>Week 0 (Jan 9–13)</td>
<td>Introduction and overview of Course; SEER</td>
<td>Assignment: Identify a SEER dataset for the final project</td>
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<tr>
<td>Week 1 (Jan 14–20)</td>
<td>Examples of survival data; Survival functions</td>
<td>Reading: Ch. 1; 2.1–2.6</td>
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<tr>
<td>Week 2 (Jan 21–27)</td>
<td>Types of censoring and truncation</td>
<td>Reading: 3.1-3.4</td>
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<td>Week 3 (Jan 28–Feb 3)</td>
<td>Estimator of survival and cumulative hazard functions</td>
<td>Assignment: HW#1</td>
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<td>Week 4 (Feb 4–10)</td>
<td>Confidence interval for survival function, Summary curves for competing risks, Estimate hazard function</td>
<td>Reading: 4.3-4.4, 4.7; 6.1-6.2 Assignment: HW#2</td>
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<td>Week 5 (Feb 11–17)</td>
<td>A case study</td>
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<td>Week 6 (Feb 18–24)</td>
<td>Hypothesis testing: one and two sample tests</td>
<td>Reading: 7.1-7.8 Assignment: HW #3</td>
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<td>Week 7 (Feb 25–Mar 3)</td>
<td>Introduction of proportional hazards (PH) model</td>
<td>Reading: 8.1-8.4</td>
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<td>Week 8 (Mar 4–10)</td>
<td>Spring break</td>
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<td>Week 9 (Mar 11–17)</td>
<td>PH model: model building and estimation</td>
<td>Reading: 8.5-8.8 Assignment: HW#4</td>
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<td>Week 10 (Mar 18–24)</td>
<td>Cox PH model: extension of Cox PH model and parametric models</td>
<td>Reading: Ch. 9 Assignment: HW#5</td>
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<td>Week 11 (Mar 25–31)</td>
<td>Midterm</td>
<td>Reading: Ch. 1-9</td>
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<td>Week 12 (Apr 1–7)</td>
<td>Additive hazards regression models</td>
<td>Reading: Ch. 10</td>
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<tr>
<td>Week 13 (Apr 8–14)</td>
<td>Regression diagnostics</td>
<td>Reading: Ch. 11</td>
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<tr>
<td>Week 14 (Apr 15–21)</td>
<td>Parametric survival models</td>
<td>Reading: Ch. 12</td>
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<td>Week 15 (Apr 22–28)</td>
<td>Recurrent events</td>
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<tr>
<td>Week 16 (Apr 29–May 5)</td>
<td>Final project presentation</td>
<td>Assignment: final project report and presentation</td>
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