SCHOOL OF MEDICINE & DENTISTRY
UNIVERSITY of ROCHESTER MEDICAL CENTER

Survival Analysis – BST514
Fall 2016
SRB 1.412, 9:15-10:45am TR

Instructor(s): Brent A. Johnson, Ph.D.
Office Hours: 10:45-11:45pm T and by appt.
Course website, course email list: TBA
Prerequisites: BST 411 and BST 412 or BST 402

Instructional Staff

There is no TA for this course. My office is located in SRB 4.142 and office hours will be held there.

Course Description

The course topic is statistical methods for the analysis of survival and lifetime data. In addition to learning some technical aspects about survival analysis, students will learn about applications and available software to analyze data.

Course Aims and Objectives

We will motivate the course through several applications before introducing notation. Then, we will start with basic concepts and definitions central to survival data. The three main areas of statistical inference to be discussed are one-sample problems, two-sample problems, and regression. For the one- and two-sample problems, parametric and non-parametric methods will be discussed. Similarly, we will discuss both parametric and semi-parametric (i.e. Cox proportional hazards) regression methods. The initial presentation of methods will be likelihood-based; this will be followed by a re-formulation of the same concepts using counting processes and martingales. Asymptotic properties of estimators will be established using martingale-based arguments.

By the end of the course, the student should be able to recognize censored data, the potential biases that can result from ignoring censoring, and the assumptions required to obtain consistent estimators. The student should be able to express estimators as minima of the negative log-likelihoods or stochastic integrals using counting processes and outline the asymptotic properties. Finally, using existing software packages, students should be able to estimate the survivor distributions in one sample, compare survival distributions across two or more samples, and perform regression modeling for survival endpoints.

Course Policies and Expectations

Homework: You are encouraged to work in teams with your classroom peers but the write-up of the solution set must be in your own words. Homework assignments will generally be due 14 days after the day assigned (Due dates will always be made clear in class). Homework will be due at the beginning of class. Late assignments will be permitted in the case of emergency or with approval of the professor

prior to the beginning of class on the due date. Otherwise, late assignments may or may not be accepted and will be completely at the discretion of the professor.

Classroom: Please use common sense and etiquette in the classroom.

Cell phones: Cell phones and pagers should be turned off or set to vibrate for emergencies. The classroom is a place of learning and random noises present a distraction. If you must take a call, excuse yourself from the classroom. Please refrain from texting during the lecture unless it is an emergency.

Laptops: Laptop computers may be used during class for classroom activities provided they are not a distraction to the professor or students around you.

Attendance/Participation: There will be no formal attendance sheet but attendance and classroom participation figures into the final grade (See Grading Procedures). Student engagement keeps the learning active and stimulates the classroom.

Enrollment: Standard university procedures and dates will govern the successful dropping/adding of courses, changing from a letter grade to pass/fail, and auditing the course.

Finally, if an issue presents itself during class, we will try to address it straight away. If a student wishes to raise an issue privately, they can arrange an appointment with the professor.

Materials and Access

Required Text

1. Kalbfleisch, J.D. and Prentice, R. L. (2002) *The Statistical Analysis of Failure Time Data.* John Wiley & Sons, Inc.: Hoboken, New Jersey.

Advanced References

2. Cox, D.R. and Oakes, D. (1984) *Analysis of Survival Data.* CRC Press: Boca Raton, Florida.
3. Fleming, T.R. and Harrington, D.P. (1991) *Counting Processes and Survival Analysis.* John Wiley & Sons, Inc.: New York.
4. Andersen, P.K., Borgan, O., Gill, R.D., and Keiding, N. (1993) *Statistical Models Based on Counting Processes.* Springer-Verlag New York, Inc.: New York.

Applied References

5. Hosmer, D.W., Lemeshow, S., and May, S. (2008) *Applied Survival Analysis: Regression Modeling of Time-to-Event Data 2nd ed.* John Wiley & Sons, Inc.: Hoboken, New Jersey.
6. Collett, D. (2003) *Modelling Survival Data in Medical Research.* Chapman & Hall/CRC: Boca Raton, Florida.

Assignments and Grading Procedures

There will be approximately 6-8 homework assignments. The course grade will be based on homework (70%), a final project (20%), attendance + class participation (10%).

Academic Integrity

Academic integrity is a core value of the University of Rochester. Students who violate the University of Rochester University Policy on Academic Honesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since academic dishonesty harms the individual, other students, and the integrity of the University, policies on academic dishonesty are strictly enforced. For further information on the University of Rochester Policy on Academic Honesty, please visit the following website:

http://www.rochester.edu/college/honesty/docs/Academic_Honesty.pdf

Accommodations for Students with Disabilities
Students needing academic adjustments or accommodations because of a documented disability must contact the Disability Resource Coordinator for the school in which they are enrolled: http://www.rochester.edu/eoc/DisabilityCoordinators.html

Course Schedule

1. Introduction to Survival Analysis
2. One-sample problems: likelihood construction, parametric modeling, Kaplan-Meier, Nelson-Aalen estimator
3. Two-sample problems: parametric two-sample comparison, log-rank test for comparing two survival distributions
4. Regression: parametric models and Cox proportional hazards model for univariate survival data
5. Counting Processes and Martingales: revisit the Nelson-Aalen and Kaplan-Meier estimators, log-rank test, and Cox proportional hazards model. Breslow estimator for the cumulative baseline hazard function. Clarify the assumptions and study asymptotic properties.

Tentative topics:
6. Extensions of the Cox model for correlated survival data, recurrent events, etc.
7. Accelerated failure time model – Buckley-James and rank-based estimators
8. Transformation model

Important Dates:
31 August 2016: beginning of semester/classes.
13 September 2016: Move to SRB 1404
15 September 2016: Move to SRB 1406
22 September 2016: Move to SRB 1402
16-17 October 2016: Fall break.
23-27 November 2016: Thanksgiving recess.
13 December 2016: Move to SRB 1404; end of semester/classes.
15 December 2016: Move to SRB 1404 (if necessary)

Other potentially useful information for students

- UCLA statistical consulting website*: http://www.ats.ucla.edu/stat/*
- course website*: coming soon*

This template is provided for Course Heads' convenience by the Academic Technology Group, the Derek Bok Center for Teaching and Learning, the Office of Undergraduate Education and the Program in General Education. It was compiled using resources from the teaching centers of Cornell, Carnegie Mellon, Michigan and the Bok Center.