**PQHS 435: Survival Data Analysis**

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| Instructor: | Pingfu Fu  Population and Quantitative Health Sciences  Office: WG-49C |
| When/Where | Mon. Wed. 1-2:15pm, WG-73 |
| Office Hours: | By appointment:  Phone: 368-3911 or Email: [pxf16@case.edu](mailto:pxf16@po.cwru.edu) |
| Web site | Data files, SAS and S+/R programs and some course announcements will be posted on our class specific website:  *http://bfox.cwru.edu/~pxf/teaching/435.html* |
| Teaching Assistant: |  |

**Course Description**

Time-to-event data are common in biology and medicine, particularly in longitudinal or cohort studies where the onset of certain health outcomes is observed. The timing of event onset, in addition to the outcome event (e.g. development of a symptom, death), provides important information about disease progression or treatment effects. Furthermore, the outcome may not be observed on every study subject because of limitations in the study design. For example, a study may terminate before a subject develops the symptom of interest. This characteristic of incomplete observation is called censoring, must be considered in evaluating the study.

**Topics:**

Characterization of survival data; non-parametric procedures; modeling survival data; distributions frequently used to represent survival data; proportional hazards model; model checking; parametric models; extended Cox models: time dependent variables, piece-wise Cox model, etc; sample size requirements for survival studies; additional topics as time allows; SAS and S+ computer software for survival analysis.

Advanced topics (if time permits): length bias / left-truncation; multi-state model / competing risk; Informative censoring; Interval censoring; frailty and marginal models for multivariate failure time data.

**PREREQUISITES:**

A background that includes regression and analysis of variance models, as well as maximum likelihood methods of statistical theory will be necessary. You should understand the basic statistical concepts of sampling variation, parameter estimation, confidence limits, and statistical hypothesis testing At least PQHS 431/432 or equivalent is required. PQHS 481, 482 (theoretical statistics) and PQHS 414/415/416 (statistical computing) are encouraged.

**Textbook and other recommended texts**

1. Collet D. (2015). *Modeling Survival Data in Medical Research*, Chapman and Hall. Third edition – required.
2. Klein JP and Moeschberger ML (2003). *Survival Analysis: Techniques for Censored and Truncated Data,* Springer-Verlag. Second edition.
3. Kalbfleisch JD and Prentice RL (2002). *The Statistical Analysis of Failure Time Data,* John Wiley & Sons. Second edition.
4. Therneau TM and Grambsch PM (2000). *Modeling Survival Data: Extending the Cox Model*, Springer-Verlag.
5. Zhang H and Singer B (1999). *Recursive Partitioning in the Health Sciences*. [Springer,](http://www.springer-ny.com/) New York.
6. Lee, ET and Wang J. W. (2003). *Statistical Methods for Survival Data Analysis*, John Wiley & Sons. Third edition.
7. Fleming TR and Harrington DP (2005). *Counting Processes and Survival Analysis*, John Wiley & Sons. Second edition.

**SOFTWARE:**

* SAS User Guide: Basic and Statistics, Version 14, SAS Inc., Cary, NC.
* S+: *Modern Applied Statistics with S-PLUS* (by Venables and Ripley). Fourth Edition.
* R: The Grammar of Graphics (by Leland Wilkinson) and ggplot2: Elegant Graphics for Data Analysis (by Hadley Wickham).

**Tentative Lecture Schedule**

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| --- | --- | --- | --- | --- |
| Monday | |  | Wednesday | |
| Date | Section |  | Date | Section |
| 1/16 | MLK Jr. Holiday |  | 1/18 | Course Introduction, 1.1, 1.2 |
| 1/23 | 1.3, 1.4, 1.5, 2.1, 2.2 |  | 1/25 | 2.3, 2.4, 2.5 |
| 1/30 | 2.6, 2.7 |  | 2/1 | 2.8, 2.9, 2.10 |
| 2/6 | 3.1, 3.2 |  | 2/8 | 3.3, 3.4 |
| 2/13 | 3.5, 3.6, 3.7, 3.8 |  | 2/15 | 3.9, 3.10, 3.11, 3.12, 3.13 |
| 2/20 | 4.1 |  | 2/22 | 4.2 |
| 2/27 | 4.3 |  | 3/1 | 4.4, 4.5, 4.6 |
| 3/6 | 5.1, 5.2 |  | 3/8 | Midterm exam: Chapters 1 to 4 |
| 3/13 | Spring Break |  | 3/15 | Spring Break |
| 3/20 | 5.3, 5.4, 5.5 |  | 3/22 | 5.6, 5.7, 5.8 |
| 3/27 | 5.9, 5.10, 5.11 |  | 3/29 | 6.1 |
| 4/3 | 6.2, 6.3 |  | 4/5 | 6.4, 6.5 |
| 4/10 | 6.6 |  | 4/12 | 6.7, 6.8, 6.9, 6.10, 6.11, 6.12 |
| 4/17 | Review Chapters 5 to 6 |  | 4/19 | 8.1, 8.2, 8.3 |
| 4/24 | 8.4, 8.5, 8.6, 8.7 |  | 4/26 | Chapter 15 |
| 5/1 | Chapter 11 |  | 5/4- 5/11 | Final (final grades due 5/13) |

**Learning Objectives**

The objectives of this course are several folds, including (1) discussion of various methods for analyzing time-to-event data with an emphasis on using computer software for exploratory analysis, model building and model checking; (2) to enhance students' ability to independently conduct data analysis and their skills of statistical computing. Students will be able to

* characterize life time data arising from studies of intermediate level of complexity;
* identify appropriate methods for data analysis;
* understand the strength and limitation of each method;
* appreciate model building/checking process;
* use common computer software such as SAS and/or R/S+ to conduct data analysis;
* interpret results.

**Course Format**

Describe course format: The instructor will give presentations of the main topics outlined in the course description with class discussions.

**Requirements and Grading** **Scale:**

**Course Evaluation:**

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| --- | --- | --- |
| I. | Midterm examinations | 25% |
| II. | Classroom participation | 10% |
| III | Computer projects and homework (10 assignments) | 30% |
| IV | Final Examination or project | 35% |

**POLICIES:**

**Attendance:** Required. The classroom participation will be assessed using attendance lists to keep track of student names. Teaching assistant will help record students' contributions if the class is large (over 20). See also course evaluation.

**Computer projects and homework:** There are about 10 homework assignments (one every other week on average) and they will be assessed based on both completion and correctness. Students will have about a week to finish each homework assignment.

**Late assignments:** All assignments should be due on time. A late assignment is allowed with reasonable justification**.**

**Class Correspondence:** ByEmail, phone or the communication system built-in in CANVAS.

**Grading:**

The final grade will based on the criteria outlined in the course evaluation section**.** If final grade is based on final score: A if final score is 85-100; B if final score is 70-84; C if final score is 60-69; F if final score below 59.

**Incomplete grades**

The grade of Incomplete is assigned at the discretion of an instructor provided that:

1. There are extenuating circumstances, explained to the instructor before the assignment of the grade, which clearly justify an extension of time beyond the requirements established for other students in the class. It is the student's responsibility to notify the instructor of the circumstances preventing completion.
2. The student has been passing the course and only a small segment of the course remains to be completed, such as a term paper, for which the extenuating circumstances justify a special exception.

An Incomplete grade may not be assigned if a student is absent from a final examination, unless the dean has authorized the absence. Unauthorized absence from a final examination will result in a failing grade. When the student completes the work, the Incomplete is changed to an A, B, C, D, P, F, or NP.

All work for the incomplete grade must be made up and the change of grade recorded in the Office of the University Registrar by the date specified by the instructor, but no later than the last day of class in the semester following the one in which the Incomplete was received. A student who has a permanent Incomplete for a required course must retake the course in a later term. If the student cannot complete the work by the end of the following semester, he or she must petition for an extension which must be endorsed by the instructor, explain the reasons why the work has not been completed, and include a new date for completion. Students will be allowed only one extension of no more than one additional semester to complete the work for an incomplete grade.

**Laptop and cell phone use**

Although having a laptop in class opens up new learning possibilities for students, it can be used in ways that are inappropriate. It is easy for your laptop to become a distraction to you and to those around you. **Laptops are to be used only when essential to the task at hand.** Please turn off or silence all cell/smart phones, tablets, and other electronic devices for the duration of the course. Inappropriate uses will be noted and may affect the final grade.

**Diversity and Inclusion**

It is the intent that all students regardless of their background and perspective be well-served by this class. Further, we intend to present material whose content is respectful of diversity (gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture) and deliver it in a way that respects these differences as well. We expect that all students, instructors and guests will help foster an atmosphere of respect, trust and safety in the classroom.

If you have suggestions for how to make the class content or environment more inclusive, or have specific incidents to report, please reach out to the instructor. If you are not comfortable reaching out to the instructor, feel free to reach out to someone else, such as the School of Medicine Graduate Education Office ([som-geo@case.edu](mailto:som-geo@case.edu)) or the Office of Inclusion, Diversity and Equal Opportunity (OIDEO) (oideo@case.edu).

More information on University policy and resources are available on [OIDEO’s website](https://case.edu/diversity/).

**Statement on Disability and Accommodations**

Case Western Reserve University is committed to providing all students with opportunities to take full advantage of the university's educational programs. We recognize that students with documented disabilities may need assistance or accommodations in order to achieve this objective.

These policies and procedures are used in determining a student's eligibility for disability services and are applicable to all undergraduate students and all graduate students registered through the School of Graduate Studies, MSASS, the FPB School of Nursing, and the School of Medicine.

Students are responsible for initiating and continuing the processes involved in securing accommodations. The [Accessibility Information Management (AIM) system](https://andes.accessiblelearning.com/CWRU/) is an online application used to set up and manage accommodations for Case Western Reserve University students with disabilities. Through the AIM system, students can request accommodations, send accommodation notices to their professors, request alternative formats for textbooks, and schedule accommodated exams. A step by step guide on how to apply for accommodations can be found here.

Additionally, please be in contact with the Coordinator of Disability Resources, Educational Services for Students (ESS). ESS is located in 470 Sears Building. The office phone number is 216-368-5230, and the website is:<http://studentaffairs.case.edu/education/disability/policy.html>

**Academic Integrity**

Any violation of the University’s Code of Ethics will not be tolerated. All forms of academic dishonesty including cheating, plagiarism, misrepresentation, and obstruction are violations of academic integrity standards and will result in a minimum penalty of receiving a zero for the assignment, the potential for failing the entire course. Cheating includes copying from another's work, falsifying problem solutions or laboratory reports, or using unauthorized sources, notes or computer programs. Plagiarism includes the presentation, without proper attribution, of another's words or ideas from printed or electronic sources. It is also plagiarism to submit, without the instructor's consent, an assignment in one class previously submitted in another. Misrepresentation includes forgery of official academic documents, the presentation of altered or falsified documents or testimony to a university office or official, taking an exam for another student, or lying about personal circumstances to postpone tests or assignments. Obstruction occurs when a student engages in unreasonable conduct that interferes with another's ability to conduct scholarly activity. Destroying a student's computer file, stealing a student's notebook, and stealing a book on reserve in the library are examples of obstruction.

In addition, the incident will be reported to the Dean of Undergraduate Studies and Academic Review Board for undergraduates or Senior Associate Dean of Graduate Studies, for Graduate Students. The CWRU Statement of Ethics for graduate students can be found here:

<http://case.edu/gradstudies/about-the-school/policies-procedures/>

**Plagiarism**

Unless specifically stated otherwise, **the** **faculty of the PQHS expect and require original writing for all assignments given.** Submitting plagiarized work for an academic requirement is a violation of the academic integrity standards set forth by the University. Plagiarism is the representation of another's work or ideas as one's own; it includes the unacknowledged, word-for-word use and/or paraphrasing of another person's work, and/or the inappropriate unacknowledged use of another person's ideas. Submitting substantially the same work to satisfy requirements for one course that has been submitted in satisfaction of requirements for another course, without permission of the instructor of the course for which the work is being submitted, is also prohibited.

**Course Audit**

Each attendee and participant in a PQHS/MPHP/CRSP course must be registered for the course. The Department of Population and Quantitative Health Sciences does not permit the auditing of courses, either officially or unofficially, without the written approval of the instructor and the Vice Chair for Education for PQHS. Students looking to take a course outside the requirements of their degree program are encouraged to make use of the Fellowship Course option available through the School of Graduate Studies.