

PUBHBIO 7235 – Applied Survival Analysis

3 credits – Spring, 2026

Tuesday and Thursday from 12:45 to 2:05 pm in Cunz Hall 180 (or online)

Course Instructor

Eben Kenah, Professor of Biostatistics

MS in biostatistics (2008) and ScD in epidemiology (2008), Harvard School of Public Health

Office: Cunz Hall 380F

Email: kenah.1@osu.edu (please use Carmen messages for communication about class)

Instructor's Office Hours

Wednesday 9-10 am and Friday 9:30-10:30 am in Cunz Hall 380F or Zoom (links on Carmen). If these times do not work, please make an appointment via Carmen message.

Faculty Feedback & Response Times

The following gives you an idea of my intended availability during the course:

- **Grading:** You can generally expect feedback within 7-10 days.
- **Carmen messages:** I will reply to Carmen messages within 1-2 school days.
- **Discussion board:** Either the TA or the instructor will check and reply to messages in the discussion boards at least once per school day.

Graduate Teaching Assistant (GTA)

Jeongjin Lee (lee.10449@buckeyemail.osu.edu)

Office hours: Monday 3-4 pm via Zoom (link on Carmen) or by appointment

GTA Responsibilities

The GTA 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 assignments; 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

This course is 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, and competing risks analysis. The course will include analyzing real health science data using statistical software.

Prerequisites

PUBHBIO 6211, Stat 6450 or 6950, or permission of the instructor. Not open to students with credit for Stat 6605.

Course Learning Objectives

Upon completion of the course, the student will be able to:

1. Identify characteristics of time-to-event data that distinguish 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 models for survival data and interpret the output.
6. Apply appropriate model building techniques to select and assess the fit of 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.

Competencies

Foundational public health knowledge

- (#3) Explain the role of quantitative and qualitative methods and sciences in describing and assessing a population's health
- (#6) Explain the critical importance of evidence in advancing public health knowledge

Foundational MPH competencies

- (#3) Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate
- (#4) Interpret results of data analysis for public health research, policy or practice
- (#19) Communicate audience-appropriate (i.e. non-academic, non-peer audience) public health content, both in writing and through oral presentation

MPH-BIO specialization competencies

- (#1) Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results
- (#3) Identify strengths and weaknesses of standard analytic methods
- (#4) Describe basic concepts of probability, random variation and commonly used statistical probability distributions
- (#5) Use computational methods to effectively analyze complex public health and medical data

MS-BIO Specialization Competencies

- (#6) Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results
- (#7) Recognize strengths and weaknesses of study designs, data sources, and analytic methods
- (#8) Explain core concepts of probability, random variation and commonly used statistical probability distributions and how they relate to statistical inference
- (#9) Use computational methods to effectively analyze complex public health and medical data

Text/Readings:

All textbooks are available for free from University Libraries (<https://library.osu.edu>) with your Ohio State name.# login. Some links may take a few seconds to load. Any additional readings from the biostatistics or epidemiology literature will be posted on Carmen.

Primary texts:

- [*Applied Survival Analysis: Regression Modeling of Time-to-Event Data*, 2nd edition, by Hosmer, Lemeshow and May \(2008\).](#)
- [*Survival Analysis: Techniques for Censored and Truncated Data*, 2nd edition, by Klein & Moeschberger \(2003\).](#)

Secondary texts

- [*Regression Methods in Biostatistics: Linear, Logistic, Survival, and Repeated Measures Models*, 2nd edition, by Vittinghoff, Glidden, Shiboski and McCulloch \(2012\).](#) This book is used in several other PUBHBIO courses.
- [*Survival Analysis: A Self-Learning Text* by Kleinbaum and Klein \(2005\).](#)

Carmen

There is a Carmen site for this course: <https://carmen.osu.edu>. All course materials are available via Carmen. Due dates, readings, etc., on Carmen are the most accurate and up to date.

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions (<https://admin.resources.osu.edu/buckeyepass/adding-a-device>)
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application (<https://admin.resources.osu.edu/buckeyepass/installing-the-duo-mobile-application>) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

Class Format: How this course works

- **Mode of delivery:** The class will be delivered in person. Attendance at lectures is expected of all students. Should in-person classes be canceled, we will meet virtually via CarmenZoom during our regularly scheduled time. The instructor will share any updates via announcements on Carmen.
- **Credit hours and work expectations:** This is a **3-credit-hour course**. According to Ohio State policy (go.osu.edu/credithours), students should expect around 3 hours per week of time spent on direct instruction (e.g., lab sessions) in addition to 6 hours of homework or

active learning activities (e.g., reading, recorded lectures, quizzes, finishing lab assignments, and working data analysis project) to receive an average grade.

- **Attendance and participation requirements:** Attendance is expected in person or on Zoom (according to section) in all scheduled classes. If students have an extenuating circumstance (e.g. unforeseen medical issues, death in the family, etc.) that prevents their attending, they should notify the instructor before class.

Course Technology

Technology skills needed for this course

- **R** (<https://cran.r-project.org>) will be used for statistical analysis. If you are new to R, I recommend using RStudio (<https://posit.co/download/rstudio-desktop/>).
- Navigating Carmen (go.osu.edu/canvasstudent)
- CarmenZoom virtual meetings (go.osu.edu/zoom-meetings)

Required equipment

- **Computer:** current Mac (Mac OSX) or PC (Windows 10+) with high-speed internet connection
- **Calculator:** Students should have access to a scientific calculator that can perform basic arithmetic, square roots, logarithms, and exponentiation.
- **Other:** a mobile device (smartphone or tablet) to use for BuckeyePass authentication

Optional equipment (for participation in optional live office hours and/or review sessions)

- **Webcam:** built-in or external webcam, fully installed and tested
- **Microphone:** built-in laptop or tablet mic or external microphone

Required software

- **Microsoft 365 Copilot (formerly Office 365)**
All Ohio State students are now eligible for free Microsoft 365 Copilot (formerly Office 365). Full instructions can be found at go.osu.edu/office365help.

Technology support

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** <http://it.osu.edu/help>
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu

Assignments/Assessments

Quizzes: 20%

There will be one online quiz for each class session. These are meant to help you review material from the corresponding lecture (and may include background from earlier lectures). **Quizzes are open notes, but you must work on them independently.** You are allowed two attempts on each quiz, and your final score will be the maximum of the two scores. See Carmen for due dates.

Labs: 40%

There will be a lab assignment started in each class session. These are meant to build skills introduced during lectures. **You may work on the labs with other students, but each student must write their own code and answers.** You will complete a Quarto worksheet with your R code

and written answers, render it into an HTML document, and submit both the Quarto and HTML documents online.

Data analysis projects: 40%

There will be a data analysis project covering material from each class module. These are meant to test your ability to apply the methods you have learned in the lectures and labs. **The data analysis projects are open notes but must be completed independently without any assistance.** The format will be similar to that of the labs (a Quarto document rendered into HTML), but the instructions will be less prescriptive. You may revise your analysis one time before the next one is due (or before the scheduled final exam time).

Grading

The lowest two quiz scores and the lowest lab score will be dropped. Late assignments will be docked one letter grade for each day past the deadline. **If you need an extension, please send a Carmen message to the instructor before the due date.**

Grading Scale

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 grade, not lower it.

A	94 to 100	Outstanding work reflecting mastery of the material and the ability to apply it
A-	90 to <94	Excellent work that reflects mastery of the material
B+	87 to <90	Good work that reflects mastery of most of the material
B	84 to <87	Good work that reflects mastery of some of the material
B-	80 to <84	Good work that reflects mastery of a few aspects of the material
C+	77 to <80	Mediocre work that reflects familiarity with, but not mastery of, the material
C	74 to <77	Mediocre work that reflects familiarity with most of the material
C-	70 to <74	Mediocre work that reflects little familiarity with the material
D+	67 to <70	
D	61 to <67	
E	Below 61	

Class Policies

Uploading course materials to Quizlet, Chegg, etc., and sharing homework assignments or assignment keys with other students are forbidden.

Copyright Statement

This syllabus and all course materials (e.g., assignments, solution keys, course materials) are under copyright by the instructor and cannot be posted elsewhere without written permission.

Generative AI Policy

Given that the learning goals of this class are to think and write clearly about applications of ideas and methods from statistical and causal inference in epidemiology, the use of generative artificial intelligence (GenAI) tools such as Copilot or ChatGPT is not permitted in this course.

Office of Student Life: Disability Services

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let me know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.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](tel: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](tel:614-292-5766) and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

Religious Beliefs or Practices Accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the [Civil Rights Compliance Office](#). (Policy: [Religious Holidays, Holy Days and Observances](#))

Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee ([Faculty Rule 3335-5-48.7 \(B\)](#)). For additional information, see the [Code of Student Conduct](#).

Intellectual Diversity

Ohio State is committed to fostering a culture of open inquiry and intellectual diversity within the classroom. This course will cover a range of information and may include discussions or debates about controversial issues, beliefs, or policies. Any such discussions and debates are intended to support understanding of the approved curriculum and relevant course objectives rather than promote any specific point of view. Students will be assessed on principles applicable to the field of study and the content covered in the course. Preparing students for citizenship includes helping them develop critical thinking skills that will allow them to reach their own conclusions regarding complex or controversial matters.

Grievances and Solving Problems

A student who encounters a problem related to his/her educational program has a variety of avenues available to seek resolution. According to University Policies, if you have a problem with this class, you should seek to resolve the grievance concerning a grade or academic practice by speaking first with the instructor or professor. Then, if necessary, you may take your case to the department chairperson. Specific procedures are outlined in [Faculty Rule 3335-8-23](#), the [CPH Graduate Student Handbook](#), and the [CPH Undergraduate Student Handbook](#). Grievances against graduate, research, and teaching assistants should be submitted first to the supervising instructor, then to the chairperson of the assistant's department.

Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a community to reflect diversity and to improve opportunities for all. All Buckeyes have the right to be free from

harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, pregnancy (childbirth, false pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Civil Rights Compliance Office:

- Online reporting form at <http://civilrights.osu.edu/>,
- Call 614-247-5838 or TTY 614-688-8605,
- Email civilrights@osu.edu

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university employees have reporting responsibilities to the Civil Rights Compliance Office to ensure the university can take appropriate action:

- All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.
- The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member.

Course Outline

The outline below is subject to change based on the needs of the class. Carmen will always have the most current information.

Week	Date	Topics
Module 1: Defining and analyzing times to events		
1	1/13	1. Introduction
	1/15	2. Survival, hazard, and cumulative hazard
2	1/20	3. Kaplan-Meier estimator
	1/22	4. Nelson-Aalen estimator
3	1/27	5. Log-rank tests
	1/29	6. Parametric estimation for one and two samples
4	2/3	7. Means and quantiles
	2/5	8. Module 1 review
Module 2: Regression modeling of times to events		
5	2/10	9. Accelerated failure time models
	2/12	10. Hazard ratios and the Cox partial likelihood
6	2/17	11. Point estimates, confidence intervals, and tests
	2/19	12. Correction for ties and time-to-event analysis
7	2/24	13. Categorical and continuous predictors
	2/26	14. Interaction terms and risk scores
8	3/3	15. Checking the proportional hazards assumption
	3/5	16. Score, martingale, and Cox-Snell residuals
	3/10	17. Confounding and noncollapsibility of the hazard ratio
	3/12	18. Module 2 review
	3/17	<i>Spring Break</i>
	3/19	<i>Spring Break</i>
Module 3: Extensions of regression models for times to events		
10	3/24	19. Stratified models
	3/26	20. Time-varying covariates
11	3/31	21. Model building
	4/2	22. Model building II
12	4/7	23. Competing risks I
	4/9	24. Competing risks II
13	4/14	25. Joint modeling of longitudinal and survival data
	4/16	26. Module 3 review
14	4/21	27. Interval censored data
	4/23	28. Frailty

Alignment of Competencies with Assessments

Competencies	Quizzes	Labs	Data Analysis Projects
(Foundational public health knowledge #3) Explain the role of quantitative and qualitative methods and sciences in describing and assessing a population's health	X	X	X
(Foundational public health knowledge #6) Explain the critical importance of evidence in advancing public health knowledge	X	X	X
(Foundational MPH #3) Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate		X	X
(Foundational MPH #4) Interpret results of data analysis for public health research, policy or practice	X	X	X
(Foundational MPH #19) Communicate audience-appropriate public health content, both in writing and through oral presentation		X	X
(MPH-BIO #1) Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results		X	X
(MPH-BIO #3) Identify strengths and weaknesses of standard analytic methods	X	X	X
(MPH-BIO #4) Describe basic concepts of probability, random variation and commonly used statistical probability distributions	X		
(MPH-BIO #5) Use computational methods to effectively analyze complex public health and medical data		X	X
(MS-BIO #6) Address problems arising in public health and medicine through appropriate statements of hypotheses, study design, data collection, data management, statistical analysis, and interpretation of results	X	X	X
(MS-BIO #7) Recognize strengths and weaknesses of study designs, data sources, and analytic methods	X	X	
(MS-BIO #8) Explain core concepts of probability, random variation and commonly used statistical probability distributions and how they relate to statistical inference	X		
(MS-BIO #9) Use computational methods to effectively analyze complex public health and medical data		X	X