



Math 459/559 Survival Analysis

Fall 2025

Instructor: Yuming Sun

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Office Hours: WF 11:00 AM – 12:00 AM (starting Aug 29)

Zoom Office: <https://cwm.zoom.us/j/7869287456> (by appointment)

Course Dates: Aug 27, 2025 – Dec 16, 2025

Course Times: MW 3:30 PM – 4:50 PM

Classroom: Jones Hall 306

Course Description

Survival analysis is widely used in biostatistical, epidemiological, and other health related fields. This course is designed to provide you with a deep understanding of the fundamental concepts and advanced techniques for analyzing survival data, often referred to as time-to-event data. These events can be death, treatment, or relapse of disease. Throughout the course, you will learn essential topics in survival analysis, including censoring mechanisms, survival distribution, Kaplan-Meier and Nelson-Aalen estimator, comparison of treatment groups, regression models, modern machine learning methods for survival analysis. Statistical analyses will be performed using R.

Learning Outcomes

1. Understand key concepts in survival analysis, such as censoring mechanisms, survival distributions, and hazard functions.
2. Compute estimators of survival functions using methods such as the Kaplan-Meier and Nelson-Aalen estimators.
3. Perform nonparametric tests, such as Log-Rank and Wilcoxon tests, to compare survival between treatment groups.
4. Fit and interpret regression and machine learning models for survival data.

Additional learning outcomes for graduate students enrolled in Math 559

5. Quantify the uncertainty of estimators and test statistics in a mathematically rigorous way.
6. Understand estimation procedures for regression models in survival analysis.
7. Implement the full survival analysis pipeline, including data preprocessing, model fitting, and result interpretation, on complex real-world datasets.



Course Resources

- Course Website: <https://blackboard.wm.edu/>
- Textbook: no required textbooks
- Optional Textbook:
 - Klein, J. P. and Moeschberger, M. L. (2003). *Survival Analysis: Techniques for Censored and Truncated Data*, 2nd Edition. Springer, New York
 - Leemis, L. (2023). *Statistical Modeling: Regression, Survival Analysis, and Time Series Analysis*. Open Education Resources (OER).3. (<https://scholarworks.wm.edu/oer/3>)
 - Kleinbaum, D. G. and Klein, M. (2005). *Survival Analysis: A Self-Learning Text*. Springer, New York.
 - Moore, Dirk Foster. (2016). *Applied Survival Analysis Using R*. Springer, Switzerland.
 - Klein, J.P., van Houwelingen, H.C., Ibrahim, J.G., Scheike, T.H. (2013) *Handbook of Survival Analysis*. Chapman and Hall/CRC, New York.
 - Commenges, D. and Jacqmin-Gadda, H. *Dynamical Biostatistical Models*. Chapman and Hall/CRC, New York
- Computing: R

Course Policies

- R will be used for statistical analyses in the course. Students are expected to be familiar with the basic syntax and data structure of R.
- Grades and course materials will be posted regularly on Blackboard.
- Homework will be assigned approximately once every two weeks. Late homework will not be accepted.
- Makeup exams will only be considered for **VERY VALID** reasons like a serious illness or a University excused absence. Official documentation **MUST** be provided in advance.
- Exams are designed to find out what you understand. The problems on the exams will cover all of the material presented.

Participation

If you're feeling unwell, regardless of whether it's related to COVID or not, please refrain from attending the class in person. For students who test positive for COVID, it's essential to meet W&M's stipulated requirements before resuming in-person attendance. Even if your COVID test comes back



negative, if you exhibit symptoms consistent with COVID, please prioritize your health and avoid coming to class.

Consistent attendance and active participation are expected. If, due to a valid reason, you need to miss a class, please contact me in advance. For short absences of less than a week, I will assist you in catching up on missed lectures and homework reviews.

Longer absences, spanning over a week, will be handled on a case-by-case basis. Our aim is to strategize for your continued success. Zoom meetings with me are one option to keep you on track.

In the event that I need to miss a class, I will make a pre-recorded lecture and upload it to Blackboard. If I need to miss multiple classes, aside from the pre-recorded content, we will also meet for a brief homework session and answer questions during the lecture time over Zoom.

Grading Structure

Homework	30%
Mid-terms	40%
Final Exam	30%

- To achieve Learning Outcomes 5 and 6, graduate students enrolled in Math 559 will be assigned additional homework problems focused on the proof and derivation of estimators, test statistics, and estimation procedures for regression models. These problems are designed to enhance their theoretical understanding and mathematical rigor in survival analysis.
- To achieve Learning Outcome 7, graduate students will complete an additional homework assignment involving a real-world case study. They will analyze a complex real-world dataset using survival analysis techniques covered in the course and submit a written report. This assignment is designed to strengthen their ability to apply survival analysis in practical settings and will account for 30% of the total homework grade.
- No homework scores will be dropped. Homework should be turned in on 8.5×11 paper and stapled.
- There will be two midterms, and each will account for 20% of the final score. The midterms will not be cumulative. One letter sized (8.5×11) cheat sheet is allowed.
- The final exam will be cumulative, and two letter sized (8.5×11) cheat sheets are allowed.
- Final Grading Schema:



▪ 93 - 100	A	▪ 73 - 76	C
▪ 90 - 92	A-	▪ 70 - 72	C-
▪ 87 - 89	B+	▪ 67 – 69	D+
▪ 83 - 86	B	▪ 63 – 66	D
▪ 80 - 82	B-	▪ 60 – 62	D-
▪ 77 - 79	C+	▪ Under 60	F

Important Dates

- The add/drop deadline is **Sep 8**. The withdraw deadline is **Oct 27**.
- **Tentative dates for the two mid-term exams** are **Monday, Oct 6** and **Monday, Nov 17**.
- **Tentative date for the final exam** is **Monday, December 8, 9:00 AM – 12:00 PM**.

Topics Covered (subject to change)

1. Introduction to survival data
2. Functions of interest in survival analysis
3. Non-parametric one-sample estimators
4. One-, two- and k-sample hypothesis tests
5. Sample size and power (single analysis)
6. Group sequential clinical trial design
7. Parametric survival models
8. Accelerated failure time model
9. Cox regression model
10. Partial likelihood
11. Inference
12. Time-dependent covariates
13. Non-proportional hazards model
14. Model diagnostics
15. Machine learning with survival data

Students Accessibility Services

William & Mary accommodates students with disabilities in accordance with federal laws and university policy. Any student who feels they may need an accommodation based on the impact of a learning, psychiatric, physical, or chronic health diagnosis should contact Student Accessibility Services staff at 757-221-2512 or at sas@wm.edu to determine if accommodations



are warranted and to obtain an official letter of accommodation. For more information, please see [www.wm.edu/sas.](http://www.wm.edu/sas/)"

Only students with documentation from SAS are eligible for accommodations.

Honor Code

The university prides itself on creating the nation's first Honor Code. The Code provides an environment in which trust can thrive and a level playing field for students, ensuring students are evaluated based on their own effort and ability and in which students can be taken at their word. The Code reflects the university's value of integrity—in our words and our deeds. As an instructor, I strive to provide an environment that promotes integrity. Reasonable measures taken to protect us from temptation are not antithetical to the Honor Code; thus, I reserve the option to proctor exams, provide multiple copies of exams for distribution, and restrict the technology tools students can possess while taking exams.

I support the Honor Code and am obligated to report concerns for review and resolution by the Honor Council. As it is your obligation to resolve any perceived lack of understanding of my expectations in advance of submitting any work, I encourage you to contact me with any questions about my course and testing policies. You also are welcome to contact me if you have concerns that any fellow students are not fulfilling their obligation to uphold the Honor Code.

All work submitted in this course, whether in draft or final form, must be your own and must be cited appropriately.

Artificial Intelligence

You may not use GenAI tools for this assignment. This assignment's main goal is to develop your own ability to analyze and interpret survival data. Use of GenAI will not help you develop your skills and knowledge of survival analysis concepts, statistical methods, and modeling techniques.