

**PUBHBIO 8235 / STAT 7605**  
**Advanced Regression Modeling of Time-to-Event Data**  
**Spring 2019**

- Instructor:** Jared Huling, Ph.D.  
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- Office Hours:** Tues 10-11 am, Thurs 2-3 pm, or by appointment
- Lectures:** Mondays, Wednesdays, and Fridays 11:30 am - 12:25 pm, Journalism Bldg 295
- Grader:** Xiaofei Zhou, [zhou.1150@osu.edu](mailto:zhou.1150@osu.edu),
- Course Webpage:** Carmen: <http://carmen.osu.edu>  
Login with your OSU internet username (name.#) and password then go to  
STAT 7605 / PUBH-BIO 8235.

**Course Description:** This course is a follow-up to PUBH-BIO 7235 covering topics in more depth as well as introducing additional topics in survival analysis. Statistical models and methods useful for analyzing both univariate and multivariate failure time data are discussed. Topics beyond applied survival analysis include martingale and asymptotic theory, recurrent event processes, and Bayesian methods. Emphasis will be on nonparametric and semiparametric approaches for modeling, estimation and inference although parametric methods will also be shown.

**Learning Objectives:**

Upon successful completion of the course, students will have the knowledge, comprehension and/or skills to be able to use and apply commonly used statistical methods for analyzing univariate and multivariate failure time data. In particular, students will be able to:

1. Construct appropriate models for time to event data using parametric, non-parametric or semi-parametric models and both interpret results and verify model assumptions;
2. Explain basic features of counting processes and apply them to obtain asymptotic results for failure time models;
3. Formulate expressions to estimate parameters using likelihood theory for failure time models;
4. Construct models and expressions for parameter estimation for more advanced time-to-event data situations to include bivariate/multivariate survival and recurrent event data;
5. Research and present results, both orally and in writing, for an advanced topic in the field of survival analysis not covered in the course.

**Primary Text:** *Survival and Event History Analysis*, by Aalen, Borgan, and Gjessing  
Available free\* at: <http://link.springer.com/book/10.1007/978-0-387-68560-1>

**Secondary Texts:** *Survival Analysis: Techniques for Censored and Truncated Data*, 2<sup>nd</sup> edition, by Klein & Moeschberger.  
Available free\* at: <http://web.a.ebscohost.com/ehost/detail/detail?sid=03573274-452a-4fe0-8f87-f8b34f3b285e%40sessionmgr4002&vid=0&hid=4204&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=108043&db=nlebk>

*Bayesian Survival Analysis* by Ibrahim, Chen, and Sinha.  
Available free\* at: <https://link.springer.com/book/10.1007%2F978-1-4757-3447-8>

\*You must be using a University computer or signed in to the OSU library website.

**Required Software:**

R will primarily be used for all data analysis examples in class. To ensure that you obtain the best computing support from myself and the TA, **you are required to use the software package demonstrated in class for all homework.** R is available for free at <https://www.r-project.org/>.

**Grading:** Final class grade will be determined as follows:

Homework	20%
Exam 1	25%
Exam 2	25%
Final Project	30%

**Grading Scale:\*** 100-94 A  
<94-90 A-  
<90-87 B+  
<87-84 B  
<84-80 B-  
<80-77 C+  
<77-74 C  
<74-70 C-  
<70-60 D  
< 60 E

\*The instructor reserves the right to adjust the grading scale if it appears necessary due to class performance. These adjustments will only raise a student's grade not lower it.

**Exams:** There will be two in-class exams (February 22 and April 5). The exams will be closed book with THREE letter-size sheet of notes (both sides) allowed as reference. **There is no final exam.**

**Homework:** There will be six homework assignments. Homeworks 1-5 will consist of four sets of problems (A-D), with one set released per lecture. Homework 6 will consist of two sets of

problems (A&B). The following weighting scheme will be used to determine your homework grade:

Best 4 scores on HW 1-5: 20% each  
 Lowest score on HW 1-5: 10%  
 HW 6: 10%

Please refer to the course schedule below for the release dates of problem sets and homework due dates. All assignments are due on lecture days and must be turned in by the start of class (11:30 am). Late homework will not be accepted except under special, documented circumstances. **You are permitted (and encouraged!) to work together on homework, but submitted assignments must be written independently.** Homework should be submitted in hard copy with email only used in an emergency.

**Project:** Each student will individually give an in-class presentation (15 minutes) at the end of the semester. Additionally, a short report (8-10 pages) on the topic of the presentation is required as part of the project. Topic ideas and further project guidance will be provided early in the semester.

**Tentative Schedule:** *Subject to change*

Week	Date	Lecture*	Topics	Reading <sup>†</sup>	Problem Set	HW Due
1	1/7	1	Introduction to Survival Analysis and Counting Processes -- Discrete Time Stochastic Processes	ABG Ch 1.1-1.3	1A -- 1B	
	1/9	2		1.4		
	1/11	3		ABG 2.1		
2	1/14	4	More on Discrete Time Stochastic Processes, Processes in Continuous Time, Counting Process Martingales	ABG Ch 2.1, 2.2	1C -- 1D	
	1/16	5				
	1/18	6				
3	1/21		Martin Luther King Day – No Class			
	1/23	7	Censoring, Martingale CLT	ABG Ch 1.4, 2.2-2.3	2A	<b>HW 1</b>
	1/25	8			2B	
4	1/28	9	Nelson-Aalen and Kaplan-Meier Estimators, Product Limit Integral	ABG Ch 3.1, 3.2	2C	
	1/30	10				
	2/1	11			2D	
5	2/4	12	Nonparametric Tests	ABG Ch 3.3	3A	<b>HW 2</b>
	2/6	13				
	2/8	14			3B	
6	2/11	15	Competing Risks, Introduction to Cox Regression, Cox Regression: Asymptotics, Estimating Survival Function	ABG Ch 1.2, 3.4, 4.1, K&M 8.4, 8.5	3C	
	2/13	16				

Week	Date	Lecture*	Topics	Reading <sup>†</sup>	Problem Set	HW Due
	2/15	17			3D	
7	2/18	18	Cox Regression: Asymptotics, Estimating Survival Function	ABG Ch 4.1, K&M 8.4, 8.5		
	2/20	19	Review for Exam 1			<b>HW 3</b>
	2/22	20	<b>Exam 1</b>			
8	2/25	21	PH Models: Martingale & Cox-Snell Residuals, Checking for PH	ABG 4.1.3, K&M 11.2-11.4	4A	
	2/27	22				
	3/1	23			4B	
9	3/4	24	Modified Cox Models, Modeling Building Strategies	ABG 4.1.4, K&M 9.2-9.3	4C	
	3/6	25				
	3/8	26			4D	
<b>SPRING BREAK 3/11-3/15</b>						
10	3/18	27	Additive Hazards Model, Parametric Models	ABG 4.2	5A	<b>HW 4</b>
	3/20	28				
	3/22	29		ABG Ch 5.1 KM Ch 3.5, 12	5B	
11	3/25	30	Correlated Event Times, Parametric Frailty Models, Semiparametric Frailty Models	ABG Ch 6.2.1-6.2.2, 7.1-7.2	5C	
	3/27	31				
	3/29	32		ABG Ch 7.2.3-7.2.4, K&M Ch 13.3	5D	
12	4/1	33	Exam 2 Review			<b>HW 5</b>
	4/3	34	Exam 2			
	4/5	35	Bayesian Parametric Models, Bayesian Semiparametric Models			
13	4/8	36	Bayesian Parametric Models, Bayesian Semiparametric Models	ICS Ch 1.5-1.8; 2.2	6A	
	4/10	37		ICS Ch 3.1-3.2		
	4/12	38	Student Presentations		6B	<b>HW 6</b>
14	4/15	39	Student Presentations			
	4/17	40				
	4/19	41				

\* Likely to change depending on course flow.

<sup>†</sup>ABG = Aalen, Borgan, Gjessing; KM= Klein, Moeschberger; ICS = Ibrahim, Chen, Sinha

Office of Student Life: Disability Services

The University strives to make all learning experiences as accessible as possible. 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. SLDS contact information: [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; [slds.osu.edu](http://slds.osu.edu); 098 Baker Hall, 113 W. 12th Avenue.

## **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](http://ccs.osu.edu) or calling 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 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1--800--273-TALK or at [suicidepreventionlifeline.org](http://suicidepreventionlifeline.org).

## **Academic Integrity**

**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 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.**

Students must recognize that failure to follow the rules and guidelines established in the University's Code of Student Conduct, the Student Handbook, and this syllabus may constitute "Academic Misconduct." The Ohio State University's Code of Student Conduct (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the University, or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the Code of Student Conduct and the Student Handbook is never considered an "excuse" for academic misconduct, so I recommend that you review the Code of Student Conduct and the Student Handbook, specifically, the sections dealing with academic misconduct. If I suspect a student of academic misconduct in this course, I am obligated by University Rules to report these suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the University's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.