

**Course Title:** Survival Analysis

**Course Number:** BIST 0727

**Course Pre- and Co-requisite(s):** Introductory biostatistics, including hypothesis testing, confidence intervals, and linear regression; basic probability theory, including conditional probability, probability density functions, cumulative distribution functions, the binomial, Poisson, normal, and chi-square distributions; basic calculus, including derivatives, integrals, limits, function maximization; basic SAS programming; likelihood theory is desirable.

**Course Location:** School of Public Health, Piscataway, Room 234

**Course Date & Time:** Monday evenings, 6:00 – 8:00, January 25, 2021 – May 10, 2021

**Course Instructor:** Dirk F Moore, PhD. e-mail: [dirk.moore@rutgers.edu](mailto:dirk.moore@rutgers.edu)

**Office Hours:** Mondays 5 – 6 or by appointment

**Course Assistant:** None

**Course Website:** [canvas.rutgers.edu](https://canvas.rutgers.edu)

**Required Course Text:** *Applied Survival Analysis Using R (2016)* by DF Moore; no need to purchase; available on campus (or with Rutgers “netid”) for free download here:

<https://link.springer.com/book/10.1007%2F978-3-319-31245-3>

**Additional Required Text:** *Survival Analysis: A Self-Learning Text, 3<sup>rd</sup> edition* (2012) by DG Kleinbaum and M Klein. ISBN 978-1-4419-6645-2

Available on campus (or with a Rutgers “netid”) for free download here:

<http://link.springer.com/book/10.1007/978-1-4419-6646-9>

**Software:** R Version 4 with R Studio, R package “asaur”, and SAS version 9.4

**Course Description:** This is a course in survival analysis that emphasizes concepts and applications used in public health studies. The product limit estimator, the Cox proportional hazard model, and parametric models will be discussed. Censoring and truncation patterns will also be studied. Model building and checking will be discussed throughout. This course is a mathematically more advanced version of BIST 0627, with additional work required of students.

**Selected Concentration Competencies Addressed:** The competencies addressed in this course for the MS degree are:

1. Apply probability and statistical methods to design experimental and observational studies in biomedical, clinical, and public health research
2. Use probability and statistical theory to evaluate and identify appropriate methods of analysis
3. Conduct appropriate statistical analysis of data to solve medical and public health problems
4. Use a variety of statistical computer packages
5. Communicate the results of statistical studies both in writing and orally to investigators and lay community members

Please visit the Concentration webpages on the School of Public Health's website at [sph.rutgers.edu](http://sph.rutgers.edu) for additional competencies addressed by this course for other degrees and concentrations.

**Course Objectives:** The goals of the course, and their associated competencies, are:

- Understand survival data and censoring and truncation mechanisms (1)
- Estimate survival curves for censored survival data (1,2)
- Fit survival models using the Cox proportional hazards model (2, 3, 4)
- Evaluate the validity of assumptions underlying the Cox model (3, 4)
- Modify the Cox model to accommodate time-dependent variables and multiple outcomes (2)
- Understand how to accommodate competing risks (2, 3)
- Determine the power and sample size requirements for a survival analysis study (3)
- Present a complete survival analysis project (3, 4, 5)

### Course Requirements and Grading:

1. <i>Midterm exam</i>	30%
2. <i>Final exam</i>	30%
3. <i>Project &amp; Presentation</i>	15%
4. <i>Homework</i>	15%
5. <i>Quizzes</i>	10%

Homework will be assigned weekly, and is due in class the following week. Unexcused late homework will not be accepted.

- *Grading Policy:* 94 – 100    A  
                          90 – <94    A-  
                          87 – <90    B+

84 – <87 B  
 80 – <84 B-  
 77 – <80 C+  
 70 – <77 C  
 <70 F

**Course Schedule:** Online 30 supplemental activities will be assigned regularly

Lecture	Date	Chapters	Quiz	HW Due	Topics
1	01/25	1, 2			Introduction: survival times, censoring, survival distributions, likelihood, SAS and R
2	02/1	3, 4, 5	1	1	Nonparametric survival curves, parametric models, and hazard functions
3	02/8	6	2	2	Follow-up time, confidence intervals for median survival, smooth survival curves
4	02/15	6	3	3	Censoring vs. truncation, log-rank test, Prentice modification, hypergeometric distributions
5	02/22	7	4	4	Piecewise constant hazard, stratified log-rank test and confounding, introduction to partial likelihood
6	03/01	8	5	5	Assess Weibull goodness of fit, partial likelihood with left truncation and with ties, Wald, score, and likelihood ratio tests
7	03/08		6	6	Exact method for ties, and Breslow and Efron approximations, tied discrete survival data, baseline cumulative hazard and survival predictions, review for midterm
--	03/15				Spring Break
8	03/22	9	7	7	Midterm exam
9	03/29	10	8	8	Cox proportional hazards model with covariates, both fixed and time-dependent; nested models
10	04/05	10	9	9	AIC, BIC, and stepwise Cox model search; landmark method for time-dependent variables; counting process approach to modifying the partial likelihood to accommodate time-dependence
11	04/12	11	10	10	Loess smoother for predictor variables, Schoenfeld residuals for non-proportional hazards; time-transfer function; Martingale and dfbeta residuals
12	04/19	12			Age of onset as a survival variable; competing risks and cumulative incidence functions; accelerated failure time vs proportional hazards
13	04/26		11	11	Power and sample size for survival; special topics
14	05/03				Project presentations; take-home final exam distributed
15	05/10				Take-home exam due

- *Date*
- *Topic(s), activities*
- *“Online 30” (online or outside of class activities connected to contact hours)*
- *Assigned Readings Due*
- *Assignments Due*
- *Link to Competencies and Assessments (If Option 2 from above is selected)*

**Learning Management System:** Canvas will be used extensively throughout the semester for course syllabus, assignments, announcements, communication and/or other course-related activities. It is the student’s responsibility to familiarize themselves with Canvas and check it regularly. If you have difficulties accessing Canvas, please inform the instructor and Canvas Support ([help@canvas.rutgers.edu](mailto:help@canvas.rutgers.edu)). Canvas is accessible at [canvas.rutgers.edu](https://canvas.rutgers.edu).

**School of Public Health Honor Code:** The School of Public Health Honor Code is found in the School Catalog ([sph.rutgers.edu/academics/catalog.html](https://sph.rutgers.edu/academics/catalog.html)). Each student bears a fundamental responsibility for maintaining academic integrity and intellectual honesty in his or her graduate work. For example, all students are expected to observe the generally accepted principles of scholarly work, to submit their own rather than another’s work, to refrain from falsifying data, and to refrain from receiving and/or giving aid on examinations or other assigned work requiring independent effort. In submitting written material, the writer takes full responsibility for the work as a whole and implies that, except as properly noted by use of quotation marks, footnotes, etc., both the ideas and the works used are his or her own. In addition to maintaining personal academic integrity, each student is expected to contribute to the academic integrity of the School community by not facilitating inappropriate use of her/his own work by others and by reporting acts of academic dishonesty by others to an appropriate school authority. It should be clearly understood that plagiarism, cheating, or other forms of academic dishonesty will not be tolerated and can lead to sanctions up to and including separation from the Rutgers School of Public Health.

**Students with Disabilities:** Rutgers University welcomes students with disabilities into all of the University’s educational programs. In order to receive consideration for reasonable accommodations, a student must apply for Services by first completing a Registration Form with the Rutgers Office of Disability Services (ODS) at [ods.rutgers.edu](https://ods.rutgers.edu). The student will also be required to participate in an ODS intake interview and provide documentation. If reasonable accommodations are granted, ODS will provide you with a Letter of Accommodations which should be shared with your instructors as early in your courses as possible.

**Commitment to Safe Learning Environment:** The Rutgers School of Public Health is committed to helping create a safe learning environment for all students and for the School as a whole. Free expression in an academic community is essential to the mission of providing the highest caliber of education possible. The School encourages civil discourse, reasoned thought, sustained discussion, and constructive engagement. Provocative ideas respectfully presented are an expected result. An enlightened academic community, however, connects freedom with responsibility. The School encourages all students to disclose any situations where you may feel unsafe, discriminated against, or harassed. Harassment or discrimination of any kind will be not tolerated and violations may lead to disciplinary actions.

**Reporting Discrimination or Harassment:** If you experience any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking, know that help and support are available. You may report such incidents to the [RBHS Title IX Office](#) or to the School of Public Health’s [Office of Student Affairs](#). Rutgers University has staff members trained to support survivors in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, and more. If you experience any other form of discrimination or harassment, including racial, ethnic, religious, political, or academic, please report any such incidents to the School’s [Office of Student Affairs](#). The School strongly encourages all students to

report any incidents of discrimination or harassment to the School. Please be aware that all Rutgers employees (other than those designated as confidential resources such as advocates, counselors, clergy and healthcare providers as listed in Appendix A to [Policy 10.3.12](#)) are required to report information about such discrimination and harassment to the School and potentially the University. For example, if you tell a faculty or staff member about a situation of sexual harassment or sexual violence, or other related misconduct, the faculty or staff member must share that information with the [RBHS Title IX Coordinator](#). If you wish to speak to a confidential employee who does not have this reporting responsibility, you can find a list of resources in Appendix A to University [Policy 10.3.12](#). For more information about your options at Rutgers, please visit [Rutgers Violence Prevention and Victim Assistance](#).

**Graduate Student Computer Policy:** Students are required to possess a personal laptop, no older than approximately two years, that must meet minimum requirements which may be found online at: [sph.rutgers.edu/student-life/computer-support.html](http://sph.rutgers.edu/student-life/computer-support.html)

**Policy Concerning Use of Recording Devices and Other Electronic Communications Systems:**

When personally owned communication/recording devices are used by students to record lectures and/or classroom lessons, such use must be authorized by the faculty member or instructor who must give either oral or written permission prior to the start of the semester and identify restrictions, if any, on the use of mobile communications or recording devices.

**Policy Concerning Use of Turnitin:** Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com (directly or via learning management system, i.e. Canvas) for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Usage Policy posted on the Turnitin.com site. Students who do not agree should contact the course instructor immediately.

**Withdrawal/Refund Schedule:** Students who stop attending their course(s) without submitting a completed [Add/Drop Course](#) form will receive a failing grade. Furthermore, students dropping to zero credits for the semester are considered withdrawn and must submit a completed [Leave of Absence](#) form from the School of Public Health's Office of Student Affairs. The School of Public Health refunds tuition only. Administrative and technology fees are non-refundable. You may find the Withdrawal/Refund Schedule on the School of Public Health website at: [sph.rutgers.edu/academics/academic-calendar.html](http://sph.rutgers.edu/academics/academic-calendar.html)

### Remote Learning Policies

As you know, we are engaged in this course under extraordinary circumstances. Not only are we now conducting the class remotely, but we are all working under the repercussions of the COVID-19 pandemic. The following are class policies for our class sessions with Zoom. Please read carefully; these policies apply to the Spring 2021 semester. All students are expected to adhere to the policies.

General: Log into Zoom using your Rutgers NetID and sign-in with your full first name and last name as listed on the class roster. (If you use a different name than what is listed on the class roster, please email the instructor in advance of the class or send a private Chat message.) Using your full name allows the instructor to know who is in attendance and to quickly sort students into their groups when needed. Users who do not log into Zoom using their Rutgers NetID may have trouble accessing the Zoom classroom.

Video: Please turn on your video when possible. We recognize that this isn't always easy but this will help to build our class community. Seeing the faces of your classmates more closely duplicates the typical in-person learning experience and may shift your mindset into more focus and attention. Seeing each other can also provide each of us with positive social interactions.

- If you're unable to find an environment without a lot of visual distractions or prefer to not show your living space as a background, feel free to use a virtual background (several virtual background images created by the School of Public Health are available in the [Student Connect Canvas page](#)).
- To save bandwidth, there may be times during class when the instructor asks students to turn off videos.
- Add a photo to your Zoom profile. (Then in times when videos are off, we'll see photos of everyone rather than an empty box.)
- If you have limited internet bandwidth or other issues impacting your video use, please inform the instructor.

Audio: Mute your microphone when you are not talking. This helps eliminate background noise.

- Use a headset, if possible. If you own headphones with a microphone, please use them. This improves audio quality.
- Be in a quiet place, if possible. Turn off any music, videos, etc. in the background.

Chat: Stay on topic and be respectful. Use the chat window for questions and comments that are relevant to class.

NOTE: Class meetings on Zoom will be recorded and made available for students in the course on Canvas only.

### **Special Circumstances During COVID-19 (For Spring 2021)**

The School of Public Health recognizes that students may experience challenges or be negatively impacted due to the COVID-19 pandemic, mental and emotional health toll from systemic racism, altered personal and professional obligations, and other crises existing at the moment in our local, national, and global communities. Students are encouraged to discuss these challenges and circumstances with their instructor, if they feel they may need additional support or temporary accommodations at the beginning or during this course. The course instructor may consider making reasonable temporary adjustments depending on the student's situation. If additional support is needed, students may reach out to the [Office of Student Affairs](#) ([studentaffairs@sph.rutgers.edu](mailto:studentaffairs@sph.rutgers.edu)) or any of the appropriate referral resources listed on the [Student Connect Canvas page](#).