

Course Title: *Advanced Theory of Biostatistics I (9/2-12/21)*

Course Number: *BIST 0700*

Course Pre- and Co-requisite(s): *Biostatistics Theory I & II (BIST 0613 & BIST 0614)*

Course Location: <https://rutgers-hipaa.zoom.us/j/97878960699?pwd=U0Z2NWFqbFlbC9LYXNPL094YzQwQT09>

Course Date & Time: *Monday 3:00 pm – 6:00 pm*

Course Instructor: *Yong Lin, Ph.D., Professor, Department of Biostatistics and Epidemiology, Rutgers School of Public Health, Room 214
Phone: (732)-235-5513, email: linyo@sph.rutgers.edu*

Office Hours: *Monday 2:00pm-3:00pm, or by appointment*

Course Assistant: *None*

Required Course Text: *Essential Statistical Inference: Theory and Methods (Springer Texts in Statistics) (2013), [Dennis D. Boos](#) and [Leonard A. Stefanski](#). (ISBN-13: 978-1-4614-4817-4)*

Additional/Supplemental Readings/Resources:

- *Mathematical Statistics*, 2nd Edition, Jun Shao (2008), Springer. (ISBN-13: 978-0387953823)
- *Statistical Inference*, 2nd Edition, George Casella and Roger L. Berger, Duxbury Thomson Learning. (ISBN-13: 978-0534243128)
- *Theory of Point Estimation*, 2nd Edition, E.L. Lehmann and George Casella (1998), Springer-Verlag. New York. (ISBN-13: 978-0387985022)
- *Approximation Theorems of Mathematical Statistics*, Robert J. Serfling (2002), John Wiley & Sons, INC. (ISBN-13: 978-0471219279)

Course Description: *This course extends probability and statistical theory covered in BIOS 0613 and 0614 to an advanced level. The topics include common stochastic processes in biostatistics, likelihood construction, maximum likelihood estimation (MLE) and information matrix, likelihood-based tests (Wald, Score and LRT), partial, conditional and marginal likelihoods, Newton-Raphson algorithm, EM algorithm and extensions, convergence and limit theorems, and asymptotic theory for likelihood-based methods. This course also includes the inference for regression models and the theory of statistical estimation, unbiasedness, consistency, and efficiency.*

Selected Concentration Competencies Addressed: *Each Department identifies competencies for each degree offered. The competencies addressed in this course for the Ph.D. for the Department of Biostatistics include:*

- *Demonstrate understanding of fundamental probability theory and statistical models to solve public health research questions.*
- *Demonstrate understanding of fundamental probability theory to address public health or medical problems*
- *Reinforce the review and critical methods and interpretations presented in published research studies, presentations of reports*
- *Reinforce use statistical computer packages to organize, analyze, and report collected data*

These competencies will be assessed throughout the lectures, homework and exams.

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

Course Objectives: *By the completion of this course, students will be able to:*

1. *learn the advanced probability and statistical theory that are most critical for a doctoral level biostatistician.*
2. *be able to appraise the methodological perspectives in a majority of other courses they need to take, as well as, in their dissertation work.*
3. *be able to use the tools needed for doctoral level biostatistician for their research and can begin to read and understand journal articles.*

Course Requirements and Grading:

- **Course Evaluation Description:**

- *Lectures will be given each week.*
- *Homework will be assigned almost every week. Students are allowed to work in groups on homework if they like, but no one should copy directly from someone else's paper.*
- *There will be an in-class, closed book midterm exam.*
- *A project will be assigned at the end of semester. It will likely be to read a journal article and make a 10-15 minute in-class presentation.*
- *There will be an in-class, closed book final examination.*

- **Grading policy:**

The course grade will be based on homework assignments, the midterm exam, the final exam, a project, and class participation. The relative weight given to each of these components is

1) Homework	20%
2) Midterm Exam	35%
3) Project	10%
4) Final Exam	35%
Total:	100%

- *School-wide uniform grading scale:*

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:

Date	Class	Topic(s)
09/14	1	<i>Introduction, basic measure theory, probability theory, location-scale families</i>
09/21	2	<i>Exponential families, sufficient and complete statistics,</i>
09/28	3	<i>Unbiasedness, likelihood definition and construction, discrete data likelihoods</i>
10/05	4	<i>multinomial likelihoods, continuous data likelihoods, likelihoods with both discrete and continuous components,</i>
10/12	5	<i>mixtures and censored data likelihoods, random censoring,</i>
10/19	6	<i>Information matrix, Likelihood-based tests (LRT, Wald and Score Tests) for simple hypothesis</i>
10/26	7	Midterm exam
11/02	8	<i>Likelihood-based tests (LRT, Wald and Score Tests) for composite hypothesis, and confidence Intervals</i>
11/09	9	<i>Likelihood for regression models, conditional and marginal likelihoods, partial likelihood.</i>
11/16	10	<i>Newton-Raphson algorithm, EM algorithm and extensions</i>
11/23	11	<i>Stochastic convergence, consistency and efficiency</i>
11/30	12	<i>Tools for proving large sample results</i>
12/07	13	<i>Asymptotic theory for likelihood-based methods</i>
12/14	14	<i>Project presentation and review</i>
12/21	15	Final Examination

**The above course schedule provides a general plan for the course; some deviations may be necessary.*

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). Canvas is accessible at 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). 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. 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

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