

Course Title: Advanced Biostatistical Computing

Course Number: BIST 0720

Course Pre- and Co-requisite(s): BIST 0613 (Biostatistics Theory I)
BIST 0614 (Biostatistics Theory II)
BIST 0610 (Advanced Regression Methods)

Course Location:

<https://rutgers.zoom.us/j/95665669610?pwd=WGFzT1J4c25JY1YwNFdmc0lJQW9oQT09>

Course Date & Time: Mondays 12:30–2:30 PM

Course Instructor: Wei Vivian Li, PhD, Assistant Professor
Department of Biostatistics and Epidemiology
vivian.li@rutgers.edu

Office Hours: Mondays 2:30-3:30 PM or by appointment

Course Assistant: NA

Course Website: <https://rutgers.instructure.com/courses/103289>

Course Text:

Tools for Statistical Inference, 3rd edition, by Marin A. Tanner, Springer, 1996, ISBN: 0-387-94688-8

Additional/Supplemental Readings/Resources:

Monte Carlo Statistical Methods, 2nd Ed. By Christian P. Robert, George Casella, Springer, 2005, ISBN: 0387212396

Course Description: Statistical computing is an important part of Statistics/Biostatistics Research. This course will cover advanced statistical computing techniques widely used in Statistics/Biostatistics Research. Topics in this course will include dimensionality reduction, random variable generation, Monte Carlo Integration, Markov chains, Monte Carlo Optimization, EM algorithm, Metropolis-Hastings algorithm, the Gibbs sampler. R and/or C++ will be used as programming tools in the class.

Selected Concentration Competencies Addressed: The competencies addressed in this course for the PhD in *Biostatistics* include:

- Apply new and existing probability and statistical models to address public health or medical problems
- Review and critique statistical methods and interpretations presented in published research studies, presentations or reports
- Conduct complex statistical analyses for a broad range of applications

- Use statistical computer packages to organize, analyze and report collected data
- Communicate the results of statistical studies both orally and in writing to senior statisticians and other investigators
- Develop new statistical methodologies to solve new biomedical, clinical and public health research problems.

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:

- Understand and implement advanced statistical computing tools.
- Program with R language and C++ language.
- Integrate and perform statistical methodologies and the available computing tools for their research.
- Generate random variables with desirable distributions.
- Perform advanced statistical computing methods, such as Markov chain Monte Carlo.

Course Requirements and Grading:

The course grade will be based on homework assignments, projects, and class participation. The relative weight given to each of these components is

1. Participation	10%
2. Homework	30%
3. Midterm project	25%
4. Final project	35%
Total	100%

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

1. There will be biweekly homework assignments. On all homework assignments/problem sets, students are encouraged to discuss with one another, but work should be carried out and written up independently.
2. It's the students' responsibility to make their papers legible. Unreadable work will NOT be graded.
3. The students are asked to answer each question as accurately and concisely as possible. If it is necessary to attach the computer output with the homework assignment, ONLY the "essential" segments are required. Do NOT submit the complete output section or the log file.

4. Unless the instructor is notified beforehand, late homework will NOT be graded. Late homework will be graded with a 10% per day penalty.
5. There will be midterm and final projects.

Course Schedule:

(Tentative)

Week	Date	Course Topic	Online30
1	Jan 25	Course overview; Principal component analysis	Paper reading
2	Feb 1	Non-negative matrix factorization	Paper reading
3	Feb 8	Stochastic neighbor embedding; Rcpp	Video tutorial
4	Feb 15	Random variable generation	Online tutorial
5	Feb 22	Normal approximations to likelihoods	Online tutorial
6	Mar 1	Non-normal approximations to likelihoods Monte Carlo integration	Online tutorial
7	Mar 8	Monte Carlo optimization Expectation-maximization algorithm	Online tutorial
8	Mar 15	Spring Recess	
9	Mar 22	Midterm Presentation	
10	Mar 29	Expectation-maximization algorithm	Online tutorial
11	Apr 5	Data Augmentation	Online tutorial
12	Apr 11	Markov Chain MCMC basics	Online tutorial
13	Apr 19	MCMC – Gibbs sampler	Online tutorial
14	Apr 26	MCMC – Metropolis algorithm	Online tutorial
15	May 3	Review	
16	May 10	Final Presentation	

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) or any of the appropriate referral resources listed on the [Student Connect Canvas page](#).

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).
- 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. 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.

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

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