

**University of Florida**  
**College of Public Health & Health Professions Syllabus**  
**PHC7068: Biostatistical Computing (3 credits)**

Fall: 2024

Delivery Format: *On-Campus*  
Course Website: [elearning.ufl.edu](http://elearning.ufl.edu)

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Instructor Name: Arkaprava Roy, PhD

Room Number: CTRB 5220

Phone Number: 352-294-5924

Email Address: [ark007@ufl.edu](mailto:ark007@ufl.edu)

Office Hours: Any course-related questions can be emailed any time of the week, preferable M-F 10am-5pm for quicker response.

Preferred Course Communications: Email or Canvas Message

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### **Prerequisites**

Prerequisites: PHC 6092, PHC 6050C, PHC 6051 (or equivalent) Or permission of the instructor.

Specifically, working knowledge of Calculus, Linear algebra, and familiarity with some programming language.

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### **PURPOSE AND OUTCOME**

#### **Course Overview**

In this course, students will learn key algorithms for advanced statistical computing and their applications in biomedical sciences. The course will cover fundamental computational techniques for biostatistical data analysis as well statistical methods for random number generation, convex optimization algorithms, Monte Carlo integration, and stochastic optimization.

#### **Relation to Program Outcomes**

This course will prepare students for PhD-level work in biostatistics by covering the theory behind common statistical computing algorithms and their applications in public health and biomedical sciences. This is a core course in the biostatistics PhD program and will help students work toward the following degree competency:

- Apply state-of-the-art biostatistical methodology to address research questions in the health sciences
- Develop efficient dissemination algorithms to use in broader scientific community.

#### **Course Objectives and/or Goals**

Upon successful completion of the course, students should be able to:

- Convert an algorithm into a workable program and write functions that others can use and understand.
- Construct a simulation study and use it to evaluate the size and power of a statistical test or method.
- Use resampling techniques such as the bootstrap and cross-validation to assess model fit and compare competing models.
- Implement computational methods for optimization (e.g., Newton-Raphson), numerical integration (e.g., Monte Carlo integration), and regression (e.g., LASSO).

- Conduct Bayesian analysis for biostatistical data.

### Instructional Methods

Lectures with slides, data analysis demonstrations in R and/or Python, and whiteboard use. Evaluation with elaborate Homework assignments, quizzes, and one end term exam.

The primary mechanism for communication in this course, other than class meetings, is conducted through the Canvas system <https://ufl.instructure.com/> to deliver in class assignments, home works, final exams and grades. It is imperative that students familiarize themselves with Canvas, check Canvas frequently for possible announcements, and make sure that their e-mail account in Canvas is correct and active. Lecture notes will be uploaded at least a week advance for each class.

### Recommended texts

John Monahan, Numerical Methods of Statistics, 2nd Edition, Cambridge University Press (2011)

Kenneth Lange, Numerical Analysis for Statisticians, 2nd Edition, Springer (2010)

James Gentle, Computational Statistics, Springer (2009)

<https://www.stat.cmu.edu/~ryantibs/convexopt/>

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## DESCRIPTION OF COURSE CONTENT

### Topical Outline/Course Schedule

Week	Dates	Topics	HWs
Week 1	8/22-8/24	Matrix operation and Algebra review	HW 1 distributed
Week 2-3	8/29-9/7	Dimension reduction PCA, SVD, CCA	
Week 4	9/12-9/14	Restricted ML + EM-algorithm + Numerical integration	HW 2 distributed
Week 5-6	9/19-9/21	Introduction to Penalization methods and some screening methods	
Week 7	9/26-9/28	Bootstrapping and Permutation	HW 3 distributed
Week 8	10/3-10/5	Convex Functions + basics on convex optimization	
Week 9	10/10-10/12	Gradient Descent + Coordinate descent	HW 4 distributed
Week 10	10/17-10/19	Simulate random variables – Simulation - Cross validation - Monte Carlo methods	
Week 11	10/24-10/26	Newton's Method + BFGS	HW 5 distributed
Week 12	10/31-11/2	Conjugate Gradient+ Constrained optimization	

Week 13	11/7-11/9	Proximal Gradient descent + Stochastic gradient descent	
Week 14	11/14-11/16	Markov Chain Monte Carlo – MH sampling & Gibbs	HW 6 and 7 distributed
Week 15	11/28-11/30	Gradient based MH sampling	

### Course Materials and Technology

Required text: There is no required text. Following are some recommended books which are some of the good for learning advanced statistical computing.

Recommended text:

John Monahan, Numerical Methods of Statistics, 2nd Edition, Cambridge University Press (2011)

Kenneth Lange, Numerical Analysis for Statisticians, 2nd Edition, Springer (2010)

James Gentle, Computational Statistics, Springer (2009)

For technical support for this class, please contact the UF Help Desk at:

- [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu)
- (352) 392-HELP - select option 2
- <https://lss.at.ufl.edu/help.shtml>

### Additional Academic Resources

[Career Connections Center](#): Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.

[Library Support](#): Various ways to receive assistance with respect to using the libraries or finding resources.

[Teaching Center](#): Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.

[Writing Studio](#): 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.

Student Complaints On-Campus: [Visit the Student Honor Code and Student Conduct Code webpage for more information.](#)

On-Line Students Complaints: [View the Distance Learning Student Complaint Process.](#)

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## ACADMIC REQUIREMENTS AND GRADING

### Grading

**Homework Assignments (70% total; 10% each).** There are a total of 7 homework assignments that will be assigned throughout the course, approximately every two weeks. Students will have 2 weeks to work

on each assignment, each of which are substantial, before submitting to Canvas. These assignments will require computational skills taught in all previous lectures to that point. The questions will assess the students' coding abilities in terms of computational efficiency as well as implementation of different and/or new statistical methods. These assignments may be completed using R or Python.

**In-Class Quizzes (15% total; 3% each).** There will also be regular in-class quizzes to check the students' abilities to convert algorithms discussed in the class into portable computer codes before distributing the example codes. Quizzes will be conducted through Canvas and will be distributed during the second period of the two-period class sessions. These quizzes will require multiple choice and/or short answer responses and will be graded for correctness. There will be a total of 5 quizzes throughout the semester, and students will be notified about upcoming quizzes at the beginning of the week.

Assignment	Points	Weight
Homework 1	100	10%
Homework 2	100	10%
Homework 3	100	10%
Homework 4	100	10%
Homework 5	100	10%
Homework 6	100	10%
Homework 7	100	10%
Quizzes	100	15%
End term exam	100	15%
<b>Totals</b>	<b>800</b>	<b>100%</b>

Students are responsible for all course material, including reading required materials prior to each class.

Point system used (i.e., how do course points translate into letter grades).

**Example:**

Percentage Earned	Letter Grade
93-100	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
67-69	D+
63-66	D
60-62	D-
Below 60	E

Please be aware that a C- is not an acceptable grade for graduate students. The GPA for graduate students must be 3.0 based on 5000 level courses and above to graduate. A grade of C counts toward a graduate degree only if based on credits in courses numbered 5000 or higher that have been earned with a B+ or higher.

<b>Letter Grade</b>	<b>Grade Points</b>
A	4.0
A-	3.67
B+	3.33
B	3.0
B-	2.67
C+	2.33
C	2.0
C-	1.67
D+	1.33
D	1.0
D-	0.67
E	0.0
WF	0.0
I	0.0
NG	0.0
S-U	0.0

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

### **HW and quiz policy**

Students may not share HW, Quiz and Exam. solutions with anyone else at any time, even after the course is finished.

### **Policy Related to Make up Work**

In the event of unusual circumstances, a student could be given additional time to complete the homeworks as per the instructor's own judgement of the situation.

Homework assignments must be submitted by 12 p.m. of the due date. Late assignments will not be accepted after the due date without an official excused absence.

### **Policy Related to Required Class Attendance**

Excused absences must be consistent with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>). Additional information can be found here: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

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## **STUDENT EXPECTATIONS, ROLES, AND OPPORTUNITIES FOR INPUT**

## **Expectations Regarding Course Behavior**

All students are expected to remain actively engaged in lecture material and participate in class discussions. Out of respect for your peers, cell phones and off-topic use of laptops will not be tolerated. Not only will these distractions interfere with the student's ability to learn, but they will also interfere with the learning of their classmates.

## **Communications Guidelines**

When communicating with classmates or the instructor, especially when using email messages or Canvas discussions, please be courteous and respectful to avoid hindering the learning community established by the course. For information on netiquette guidelines, go to <http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf>

## **Academic Integrity**

Students are expected to act in accordance with the University of Florida policy on academic integrity. As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge:

**“We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.”**

You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied:

**“On my honor, I have neither given nor received unauthorized aid in doing this assignment.”**

It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

<http://gradschool.ufl.edu/students/introduction.html>

Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.

## **Recording Within the Course:**

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or

persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

#### [Policy Related to](#) **Guests Attending Class:**

Only registered students are permitted to attend class. However, we recognize that students who are caretakers may face occasional unexpected challenges creating attendance barriers. Therefore, by exception, a department chair or his or her designee (e.g., instructors) may grant a student permission to bring a guest(s) for a total of two class sessions per semester. This is two sessions total across all courses. No further extensions will be granted. Please note that guests are **not** permitted to attend either cadaver or wet labs. Students are responsible for course material regardless of attendance. For additional information, please review the Classroom Guests of Students policy in its entirety. Link to full policy: <http://facstaff.php.ufl.edu/services/resourceguide/getstarted.htm>

#### **Online Faculty Course Evaluation Process**

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

#### **Online Synchronous Sessions**

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

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## **SUPPORT SERVICES**

### **Accommodations for Students with Disabilities**

If you require classroom accommodation because of a disability, it is strongly recommended you register with the Dean of Students Office <http://www.dso.ufl.edu> within the first week of class or as soon as you believe you might be eligible for accommodations. The Dean of Students Office will provide documentation of accommodations to you, which you must then give to me as the instructor of the course to receive accommodations. Please do this as soon as possible after you receive the letter. Students with

disabilities should follow this procedure as early as possible in the semester. The College is committed to providing reasonable accommodations to assist students in their coursework.

### **Counseling and Student Health**

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The **Counseling and Wellness Center** 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test anxiety. Visit their web site for more information: <http://www.counseling.ufl.edu>. On line and in person assistance is available.
- **U Matter We Care** website: <http://www.umatter.ufl.edu/>. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.
- The **Student Health Care Center** at Shands is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at Shands offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: <https://shcc.ufl.edu/>
- Crisis intervention is always available 24/7 from: Alachua County Crisis Center: (352) 264-6789 <http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx>
- **University Police Department:** [Visit UF Police Department website](#) or call 352-392-1111 (or 9-1-1 for emergencies).
- **UF Health Shands Emergency Room / Trauma Center:** For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; [Visit the UF Health Emergency Room and Trauma Center website.](#)

Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

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### **Inclusive Learning Environment**

Public health and health professions are based on the belief in human dignity and on respect for the individual. As we share our personal beliefs inside or outside of the classroom, it is always with the understanding that we value and respect diversity of background, experience, and opinion, where every individual feels valued. We believe in, and promote, openness and tolerance of differences in ethnicity and culture, and we respect differing personal, spiritual, religious and political values. We further believe that celebrating such diversity enriches the quality of the educational experiences we provide our students and enhances our own personal and professional relationships. We embrace The University of Florida's Non-Discrimination Policy, which reads, "The University shall actively promote equal opportunity policies and practices conforming to laws against discrimination. The University is committed to non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, gender



identity and expression, marital status, national origin, political opinions or affiliations, genetic information and veteran status as protected under the Vietnam Era Veterans' Readjustment Assistance Act." If you have questions or concerns about your rights and responsibilities for inclusive learning environment, please see your instructor or refer to the Office of Multicultural & Diversity Affairs website: [www.multicultural.ufl.edu](http://www.multicultural.ufl.edu).