

**University of Florida**  
**College of Public Health & Health Professions Syllabus**  
**PHC 6064 Survey of Advanced Biostatistical Methods for the Health Sciences**  
**3 credits, Spring 2023**

Delivery Format: On-Campus      Canvas: <http://elearning.ufl.edu>

Instructor: Jonathan Fischer  
 Locations: Communicore C1-04 (Tue 1:55 – 2:45 pm)  
 Communicore C1-009 (Thu 1:55 – 3:50 pm)  
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 Office Hours: TBD  
 Teaching Assistants: TBD  
 Preferred Course Communications: Canvas messages

**Prerequisites:** *PHC6052 or permission of instructor. You should have at least one prior course in statistics and some exposure to R or SAS.*

## **PURPOSE AND OUTCOME**

### **Course Overview**

Uniquely blends the fundamentals of biostatistical inference with an introduction to advanced statistical techniques critical for the analysis of the growing compendium of health-related data. Topics span the analysis of high-dimensional, categorical, and longitudinal data from the health sciences. Applications utilize the statistical software packages R and SAS.

### **Course Description**

A survey of biostatistical methods beyond basic testing and inference procedures. This course provides an overview of the advanced statistical procedures which are necessary for quantitative analysts and practitioners in the health sciences. Topics include complex regression models for independent, structured, and high-dimensional data, model/variable selection, and multiple testing, plus strategies for imputing missing data, multivariate parametric and non-parametric methods with applications to health-related data. Students will have the option to use either the R or SAS software packages.

### **Relation to Program Outcomes**

This is a biostatistics course designed for students in public health and the health sciences and is also appropriate for students in the biological sciences looking to expand their quantitative analysis capabilities. It will train students to rigorously analyze potentially complicated data, enabling the assessment of public health programs as well as the critical evaluation and/or production of original research in clinical and academic settings. Moreover, students will develop their quantitative communication and presentation skills.

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

Upon completion of the course, students will be able to:

- 1) Apply statistical methods to categorical, count, or structured data that commonly arise in the health and biological sciences;
- 2) Quantify the impact of missing data and employ suitable methods in response, particularly for the censoring and missingness patterns that frequently occur in clinical and biological data;
- 3) Analyze patient survival data in epidemiological contexts;

- 4) Implement advanced dimension reduction and visualization tools to deal with high dimensional data, such as those arising in genomics;
- 5) Employ simple machine learning approaches for classification and clustering with applications in personalized medicine and case/control studies; and
- 6) Develop their own testable hypotheses and effectively communicate biostatistical techniques and results to an audience of clinicians or health workers, both via written reports and oral presentations.

### Instructional Methods

Class sessions will consist of a mix of lectures and case studies with data using R and/or SAS. Data sets, code, and lecture notes will be made available to students in Canvas. Examples make exclusive use of data from public health, clinical, biomedical, and genomic settings, and features unique to data from these sources are emphasized. Assessments will consist of weekly homework assignments and a final project (short written report and in-class discussion). The course is split into three units corresponding to methods for independent, correlated, and multivariate data. These units are shaded orange, blue, and green, respectively, in the tabular schedule below.

### Topical Outline/Course Schedule

**Unit 1—Advanced Methods for Independent Data:** What are the optimal tools when our data are independent but not amenable to the simplest approaches? For instance, how should we best predict disease status or incidence, and how can we explicitly control for confounding effects when assessing the effectiveness of treatments?

**Unit 2—Methods for Correlated Data:** How do we handle data which are correlated, whether hierarchically or temporally? Examples include comparing measurements when some patients share the same hospital or physician, monitoring metrics of public health over time, and tracking patient disease survival times.

**Unit 3—Multivariate Data Methods:** How can we group or classify individuals based on clinical or genomic covariates? For example, are there subtypes within a certain disease?

Days	Topic	Assignment
Jan 10 & 12	Contingency tables	HW 1
Jan 17 & 19	Multiple linear regression	HW 2
Jan 24 & 26	Multiple linear regression	HW 3
Jan 31 & Feb 2	Generalized linear models (Logistic regression)	HW 4
Feb 7 & 9	Generalized linear models (Poisson & NB regression)	HW 5
Feb 14 & 16	Linear mixed models	HW 6
Feb 21 & 23	Linear mixed models	HW 7
Feb 28 & Mar 2	GLMMs & GEEs	HW 8
Mar 7 & 9	Temporal data	HW 9
Mar 21 & 23	Dimension reduction	HW 10
Mar 28 & 30	Clustering	HW 11
Apr 4 & 6	Classification	HW 12
Apr 11 & 13	Missing data methods	HW 13
Apr 18 & 20	Additional topics	HW 14
Apr 25	Wrap-up	
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### Course Materials and Technology

**Texts:** There are no required texts for this course. Below are several references.

- (RMB) Vittinghoff, E., Glidden, D.V., Shiboski, S.C., and C.E. McCulloch. *Regression Methods in Biostatistics: Linear, Logistic, Survival, and Repeated Measures Models*. Second Edition. Springer: New York, 2012.
- (AMS) Der, G. and B.S. Everitt. *Applied Medical Statistics Using SAS*. CRC Press: Boca Raton, 2013.
- (ISLA) James, G., Witten, D., Hastie, T., and R. Tibshirani. *An Introduction to Statistical Learning with Applications in R*. Springer: New York, 2013.

The following table lists relevant chapters from the references for various topics. These are not required readings, but they may be beneficial. I will suggest any readings I think are especially useful during the week in which we cover that topic.

Topic	Day(s)	RMB	AMS	ISLA
Review	1-2	1-3	2	1-2
Multiple Linear Regression	3-5	4, 10	7, 8	3, 5, 6
ANOVA	6-7	3	6	
Contingency tables	8	3	4	
GLMs	9-11	5, 8	9, 10	4
LMMs	12-15	7	12, 13	
GLMMs	16-18	7	14	
Missing data	19	11	18	12
Survival analysis	20-21	6	15, 16	11
Clustering	22-24			12
Classification	25-26			8

**Software:** Students will need to use either R or SAS. R and RStudio can be downloaded free from <https://www.r-project.org/> and <https://posit.co/>. SAS can be accessed for free using SAS OnDemand for Academics ([https://www.sas.com/en\\_us/software/on-demand-for-academics.html](https://www.sas.com/en_us/software/on-demand-for-academics.html)). I will use R in class, but students may use either program to complete the course. I will provide the appropriate resources in both languages.

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>

## ACADEMIC REQUIREMENTS AND GRADING

### Assignments

- Weekly **homework assignments** will be assigned and evaluated for both completion and correctness. They will consist of guided statistical analyses using software and provided data sets with follow-up questions regarding the generated output. These assignments will allow students to practice analyzing data using the methods presented in class along with the opportunity to interpret and explain their results.
- Each student will complete a **final project** using methods discussed in class. This project consists of a proposal and the analysis of a data set of interest to the student. This culminates in a written report (< 8 pages including figures) and short in-class discussion. Projects will be assessed on the bases of accuracy and clarity, and additional guidance regarding these expectations, along with assistance selecting a suitable data set, will be provided early in the course. Software will be used to evaluate reports for originality.

## Grading

Requirement	Percent of final grade	Notes
Homework	70%	14 assignments, 5% each
Project	25%	Proposal (5%) Write-up (15%) Discussion (5%)
Participation	5%	

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.

Percentage Earned	Letter Grade
[93,100]	A
[90,93)	A-
[87,90)	B+
[83-87)	B
[80-83)	B-
[77,80)	C+
[73,77)	C
[70,73)	C-
[67,70)	D+
[63,67)	D
[60,63)	D-
< 60	E

<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 <https://catalog.ufl.edu/graduate/regulations/>

### **Policy Related to Make up Exams or Other Work**

Please notify me as soon as possible if unanticipated circumstances arise which interfere with your ability to complete an assignment on-time. Late work without prior notification and approval (unless there is an emergency) will receive a zero. Late work with prior approval (or due to an emergency) will be eligible for full credit. Any requests for make-ups due to technical issues must be accompanied by the ticket number received from e-learning support when the problem was reported to them. The ticket number will document the time and date of the problem. You must e-mail your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

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

We will follow the UF Attendance Policy. Please note all faculty are bound by the UF policy for excused absences. Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations/>).

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

### **Expectations Regarding Course Behavior**

Students are expected to show up for class prepared and on-time. Cell phones are to be silenced during class unless there is an emergency, in which case please inform the instructor.

### **Communication Guidelines**

Please see the guidelines linked here: <http://biostat.ufl.edu/current-students/e-learning-resources/e-learning-basics/etiquette-online/>.

### **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.

### **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/>.

### **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. 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.phhp.ufl.edu/services/resourceguide/getstarted.htm>

## **SUPPORT SERVICES**

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

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center. [Click here to get started with the Disability Resource Center](#). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### **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.
- You 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>

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.

### **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)