

**University of Florida**  
**College of Public Health & Health Professions Syllabus**  
**PHC 6937: Analysis of Multivariate Data (3)**  
Spring: 2025 T 8-9 (3:00-4:55pm) and R 8 (3:00-3:50pm) in HPNP G110  
Delivery Format: *On-Campus*  
Course Website in E-Learning

---

Instructor Name: Robert Parker  
Room Number: CTRB 5219  
Phone Number: 352-294-5906  
Email Address: rlp176@ufl.edu  
Office Hours: TBD  
Teaching Assistants: TBD  
Preferred Course Communications: *CANVAS InBox or Email*

### **Prerequisites**

PHC 6092, PHC 6050C, and PHC 6051 or permission of the instructor. A course in linear algebra will be very helpful but not required.

---

## **PURPOSE AND OUTCOME**

### **Course Overview**

This is an introductory multivariate statistical methods course. The aim of the course is to introduce a variety of standard statistical methods used to analyze multivariate data, emphasizing the implementation and interpretations of these methods. Topics covered include matrix computation of summary statistics, graphical techniques, the geometry of sample data, the multivariate normal distribution, inferences on a mean vector, MANOVA, multivariate regression, principal component analysis, factor analysis, classification/discrimination, as well as cluster analysis and canonical correlation analysis.

### **Relation to Program Outcomes**

This course serves the knowledge and skills student learning objectives by preparing students to communicate the underpinning of biostatistics concepts and methods and to apply biostatistical concepts and methods on one's own, including interpretation and communication of results

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

- Upon successful completion of the course, students will be able to:
- 1.0 Demonstrate an understanding of multivariate random vectors and their distributions
  - 2.0 Use basic principles of probability, statistics, and linear algebra to motivate:
    - 2.1 The comparison of mean vectors
    - 2.2 Multivariate regression and canonical correlation
    - 2.3 Principal component analysis and factor analysis
    - 2.4 Classification and clustering
  - 3.0 Produce a complete analysis of appropriate multivariate data using R or SAS for each of the methods of multivariate analysis listed above.
  - 4.0 Take a multivariate data analysis "consulting" project and
    - 4.1 Identify appropriate statistical approaches to address the client's problem
    - 4.2 Carry out a thorough and meaningful analysis of the data
    - 4.3 Clearly and effectively defend and communicate their approach and findings to the client in a report.

## DESCRIPTION OF COURSE CONTENT

### Topical Outline/Course Schedule

Week	Topic(s)	Readings	Assignments
1	Introduction and Overview Matrix Algebra	1, 2, 3.1-3.8	HW1a
2	Sample Geometry, Multivariate Normal Distribution, and Sampling Distributions	4.1-4.6	HW1b
3	Inference for Mean Vectors – One and Two Samples	5.2-5.4, 5.7	
4	MANOVA	6.1-6.6	Mini-project #1
5	Repeated Measures Analysis	6.9	HW2
6	Multivariate Regression	10.4-10.8	HW3a Mini-project #2
7	Canonical Correlation	11.1-11.6	HW3b
8	<b>Midterm</b>		
9	Classification and Clustering	15, 9.1-9.3	
10	Classification	9.4-9.7	Final Project Proposal
11	Principal Component Analysis	12.1-12.9	HW4
12	Exploratory Factor Analysis	13.1-13.7	Mini-project #3
13	Confirmatory Factor Analysis	14	HW6a
14	Final Project Presentation		HW6b
15	<b>Final Exam</b>		

### Course Materials and Technology

This course is primarily based on the following text:

*Methods of Multivariate Analysis*, Third Edition (2012), by A. C. Rencher and W. F. Christensen, Wiley. (Available for free as an e-book online through the UF library)

Recommended supplementary text:

*Applied Multivariate Statistical Analysis*, 2007, by R. A. Johnson and D. W. Wichern, Prentice Hall.

*Modern multivariate statistical techniques: Regression, classification, and manifold learning*, 2008, by A. J. Izenman, Springer.

Supplementary R text for multivariate techniques:

*An Introduction to Multivariate Analysis with R* (2011), by Brian Everitt and Tolsten Holthorn. (available as a free (possibly only via USC computers) download at [the textbook site](#)).

*An Introduction to Statistical Learning with Applications in R* (2013), by James, Witten, Hastie, and Tibshirani (available as free download at [the ISL textbook site](#)).

Computing: You will also need a laptop running R or SAS.

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

- [helpdesk@ufl.edu](mailto:helpdesk@ufl.edu)
- (352) 392-HELP - select option 2
- <https://helpdesk.ufl.edu/>

## 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](#)

## ACADMIC REQUIREMENTS AND GRADING

### Assignments

#### Homework

Homework assignments will consist of textbook and textbook-like problems that will consist primarily of R coded and analysis exercises and short calculations done by hand based on the material covered in recent weeks. Homework assignments are open-note and will be graded for accuracy.

#### Mini-Projects

The mini-projects will be mini-consulting projects that will give the students the opportunity to apply recent topics covered in class to a analyze real dataset. Students will analyze the dataset and submit the code and a written report that includes relevant, selected output along with their conclusions. The report will be graded on two equally weighted areas: “technical” and “exposition”. Below is a description of what is expected for each of these two areas:

- Technical
  - Evidence of substantial breadth and/or depth of analysis
  - Proper implementation of statistical methods
    - Note: document your numerical results (test statistics, estimated parameters, etc.) in your report so that I can properly grade your performance. Don't just show me the result of your transformation; give me the values estimated to do the transformation. Don't just interpret the discriminant function; report the standardized discriminant function coefficients. Etc.
  - Well-documented computer code (R, SAS, etc.) attached to back of report. (These pages will not count against the page limit for the report.)
- Exposition: At a level appropriate for the target audience, the report has the following qualities:
  - Introduction with explanation of problem and important issues
  - Motivation and justification for statistical methods being used
  - Understandable interpretation and conclusions
  - Professional and attractive document
    - free of spelling or other writing errors
    - conforming to specifications
    - all included tables and figures are discussed in the text
    - figures and tables are placed in the body of the text instead of in appendices
  - Important findings summarized in a brief conclusion
  - When introducing technical concepts, give both: (1) a technical definition (formula) AND (2) an intuitive explanation of the technical concept/statistic.

IMPORTANT NOTE: You are really writing to two audiences simultaneously. First, you are writing to your client for the purpose of solving her/his problem and explaining the solution at her/his level. Second, you are writing to your

professor to demonstrate your mastery of the subject. This is a difficult task. Save at least a couple of days just for writing and revising—even masterful statistical analyses cannot salvage a poorly written report.

A partially-censored rubric for grading will be provided for each project.

## Final Project

The final project will be based on a multivariate method/technique that extends beyond the core methods discussed in class. The final projects are generally 4-6 single spaced pages, not to exceed 6 pages including figures and tables. Additionally, you will turn in your slides for your oral presentation to be given in class at the end of the semester.

The intent of the term project is that you extend learning beyond what was discussed in class. Projects will incorporate at least one of the following facets:

1. Applications of multivariate analysis methods to situations that extend beyond the standard scenarios. For example, applying multivariate tools to data that: exhibit temporal or spatial dependence, have  $p \gg N$  problems, are ordinal in scale, are functional in nature (i.e., require functional data analysis), or are in some other way complicated or non-standard.
2. Applications of multivariate methods that have NOT been discussed directly in class. In these scenarios, students might view their report as if it were a 4-6 page section of a multivariate statistical methods textbook.

In all cases, students should try to do more than replicate analyses or illustrations of methods—try to find a question about your methods that goes beyond simple description of methods or analyses. Nearly all projects will use simulation (or some other ambitious quantitative comparison of competing methods). The term project need not be publishable research, but the best projects try to address some novel question.

## Exams

There will be one midterm and one cumulative final exam.

## Grading

*[The Grading Section includes the detailed methods by which students are graded and the grading rubrics. Typically for Grading Method Detail: You will list each course requirement and due dates (papers, exams, case studies, etc.) List the points or percent associated with each requirement (percentages must sum to 100%).]*

Requirement	Points or % of final grade (% must sum to 100%)
Midterm Exam	15%
Final Exam	25%
Homework	20%
Mini-Projects	25%
Final Project	15%

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.

*In addition, the Bachelor of Health Science and Bachelor of Public Health Programs do not use C- grades. [Only include if applicable; This does not apply to graduate level courses. Please remove if the course is 5XXX or above.]*

Letter Grade	Grade Points
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://gradcatalog.ufl.edu/graduate/regulations/#Grades> [Remove if course is an undergraduate level course.]

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/> [Remove if course is a graduate level course.]

## Exam Policy

*[State your policy regarding exams, including exam formats, how they will be administered and proctored, the connection between course outcomes and the intended measure of the exam, as well as any unique exam locations or times.]*

## Policy Related to Make Up Exams or Other Work

All work is expected to be submitted on Canvas by the specified due date and time. Assignments submitted one day late will be accepted at a grade penalty of 10% of the maximum points available for each day late unless arrangements have been made ahead of time with the instructor. Exams are exempt from this policy and will not be accepted late. Late submissions without penalty are available only due to illness or other unanticipated circumstances, consistent with College policy. Be prepared to provide documentation from a health care provider in such cases (e.g., a doctor's note or correspondence with the UF Computing help desk). You should email me within 24 hours of the original due date in these circumstances.

## Policy Related to Required Class Attendance

Please note all faculty are bound by the UF policy for excused absences. For information regarding the UF attendance policies, see the Graduate Catalog (<https://gradcatalog.ufl.edu/graduate/regulations/#Attendance%20Policies>). I do not take formal attendance, though attendance and participation are expected parts of the course. Please arrive on-time for class meetings to the extent possible.

Excused absences must be consistent with university policies in the Graduate Catalog (<https://gradcatalog.ufl.edu/graduate/regulations/#Attendance%20Policies>). Additional information can be found here:

## STUDENT EXPECTATIONS, ROLES, AND OPPORTUNITIES FOR INPUT

### Expectations Regarding Course Behavior

It's critical to review the weekly page in Canvas and read all announcements carefully. Each week's materials will be clearly identified on the course E-learning site. Students are expected to work through the material as scheduled. It is very important to work through all content contained on this site as directed and ask questions about the material you do not understand. Working through the content from start to finish is the best approach to achieve a high level of understanding and success in this course. In addition, it is your responsibility to review the comments and feedback we give on your graded assignments. Cell phones should not be used in class, and computers are only permissible for class-related activities.

### Communications Guidelines

Questions about course material should be asked during office hours or posted on the course discussion boards in E-Learning. Questions about specific quiz questions or issues of a personal nature should be sent by email through E-Learning. For questions asked Monday-Thursday, we will try our best to respond within 24 hours. For questions asked Friday-Sunday, we will respond by Monday or as soon as possible thereafter. Additionally, please review the UF guidelines for online communications: <https://teach.ufl.edu/wp-content/uploads/2020/04/NetiquetteGuideforOnlineCourses.docx>

### 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 Handbook for additional details:

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

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 (*remove for online courses*)**

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: <https://phhp.ufl.edu/policy-classroom-guests-of-students/>

### **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/>.

---

## 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 U 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:** <https://police.ufl.edu> 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; <https://ufhealth.org/emergency-room-trauma-center>

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)

---