AGR 5266C Field Plot Techniques (Sections 10161 and 22754)

Graduate Level – 3 credit hours

Fall 2024

Instructor: Dr. Esteban F. Rios
2005 SW 23rd Street Building 350 Off. 3, 352-301-2244, estebanrios@ufl.edu
Office Hours: Tuesdays 3 to 4 pm using the Zoom link provided in class

Teaching assistants and specific duties:

Homework and Quizzes
Nicolas Caram, PhD candidate, Agronomy Department
Office Hours: TBD

R demos
Pablo Sipowicz, PhD candidate, Plant Breeding Graduate Program
Taylor Sawyer, PhD student, Plant Breeding Graduate Program

Meeting time: Tuesdays period 7 (12:50 - 1:40 pm)
Thursday periods 7 and 8 (12:50 - 2:45 pm)

Location: Agronomy Genetics and Physiology Building 344 - 2005 SW 23rd St Bldg 344, Gainesville, FL 32608

Prerequisite
An introductory course in statistics: STA2023 or STA3024 or equivalent is required. STA6093 and R experience not required, but highly encouraged.

Course Description
The ability to design experiments, collect, summarize and analyze data, and report results is fundamental to a successful research career. This course is not intended to be a theoretical statistic class; however, we will cover some fundamental concepts to create a baseline for the applied statistical and programming component. For the most part, the course will focus on how to apply statistical and agricultural concepts when designing field and greenhouse experiments to test hypotheses in agricultural studies. The class content is delivered through lectures, labs, paper discussions, and field visits. This course provides a basis to experimental designs commonly used in field and greenhouse research experiments, in addition to providing tools and theoretical framework for data analysis using R. Students will demonstrate the learned concepts through graded quizzes, homework(s), an individual written project, and a final exam. Answers for quizzes and homework assignments are reviewed and discussed in class after submission to provide comprehensive feedback. For the individual written project, students meet with TAs and instructor during the semester to monitor progress, and comprehensive written feedback is given to students from two blind-reviewers, one TA, and the instructor. The final exam can be reviewed during office hours with the instructor.

Intended Audience
The course is designed for graduate students in the College of Agricultural and Life Sciences (CALS) conducting research experiments in plant, animal, and soil science (e.g. agronomy, horticulture, environmental horticulture, soil and water science, entomology and nematology, plant pathology, forestry, and animal science).

Course Objectives/Outcomes
The broad goal for Field Plot Techniques is to educate students on how to properly design field and greenhouse experiments, collect and analyze data in R, and interpret and communicate results. More specifically, I would like to familiarize students with fundamental elements of field experimentation: factors to consider when planning experiments, common experimental designs use in agricultural settings, data collection and analysis, and written/oral communication.
At the end of the course, students are expected to have the knowledge required to design experiments, analyze data in R, interpret statistical results and disseminate scientific findings using various channels.

Upon completion of this course, students will:

1. Master the concepts and methods required to plan and execute field and greenhouse experiments.
2. Describe experimental designs used in field and greenhouse studies: completely random design, randomized complete block design, latin square design, incomplete block designs, and different treatment arrangements such as factorial and split-plot. For each design, students will learn the following topics: fundamental concepts, randomization procedures, advantages and disadvantages for each design, partition sources of variation and calculate degrees of freedom, write linear models, perform analysis of variance and regression in R, and interpret results.
3. Apply concepts of agricultural experimentation and statistics during the online-field visits to the Plant Science Research and Education Unit and to the campus greenhouses/labs, and demonstrate the concepts learned during quizzes, homework and final exam.
4. Apply concepts of field experimentation and statistics during R labs, homework(s), paper discussion and in your individual final project. For the individual project, students will be challenged to work on their own experiment, choosing the most appropriate experimental design to test hypotheses, layout the experiment in the field/greenhouse and choose experimental units based on equipment/tools/materials available. In addition, students will use their own data, or data will be simulated based on chosen experimental design. Students will analyze data in R and provide a written and oral report of results and conclusions. Each individual project will be peer-reviewed twice during the semester, and it will serve as a comprehensive base for the student's future manuscript/thesis.

Instructor's Approach

I assume significant interest in the subject matter and willingness to put effort to learn the material, attendance and active participation in class and labs. We will cover a wide range of material during the semester. If you have not taken an introductory statistics course, and/or some basic training in R or research/experimental designs, you may need to do some extra reading and practice to aid your progress in the course (request additional reading material to the instructor and TAs). You are expected to communicate your special needs to review material covered in class/labs with the instructor or TA's during office hours.

Evaluation

Activity	Number	Points/activity	Total
Homework	3	10	30
Quizzes	4	2.5	10
Project: Part 1 – First Draft	1	10	10
Project: Part 2 – Final Submission	1	10	10
Project Oral Presentation	1	10	10
Class participation	1	10	10
Take-Home Exam	1	20	20
Total	**12**		**100**

Grading

A ≥ 91 B+ 86 to 90 B 81 to 85 C+ 76 to 80 C 71 to 75 D+ 66 to 70 D 61 to 65 E < 61

UF grading policies: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx.

Homework

There will be three homework assignments during the semester. Homework will include a range of different activities, including but not limited to literature reviews, data analysis, and paper discussions, etc. All homework will be related to the topics covered in class. Homework assignments (3) will be posted on CANVAS (https://elearning.ufl.edu) and students are required to submit answers in a PDF format using the online learning platform. You are expected to understand the R scripts and statistical analyses needed to complete homework, interpret results and conclusions. We will discuss the answers to homework questions in class the week after each deadline. Late homework submission will be penalized at a rate of 10% of the homework's grade per day.

Quizzes
Quizzes will happen randomly during lectures. They will consist of a question pertinent to the topic being discussed in class that day. Students are required to email the answer to the instructor during the allotted time period when the quiz is assigned in class. There will be no notice of when quizzes are happening and **THERE IS NO MAKE UP OF QUIZZES.**

Individual Project
Each student will have to develop a project involving the design of an experiment throughout the semester, and it is highly recommended for students to work with their own thesis/dissertation project. The final project is expected to contain a title, an introduction and a rationale for the research question, experimental design, plan to execute the design in the field or greenhouse (soil sampling, planting, fertilization, irrigation, weed management, etc.), field and considerations for conducting the experiment, data collection, R script for data analysis as supplementary information, and interpretation of the results and discussion. For students who are not conducting research yet, or those who do not have data available, we will provide simulated data according to their choice of experimental design. Each project part will be peer-reviewed by two students, TAs and the instructor. The peer-review exercise counts for "participation grade" points, and each student will be assigned at least 2 projects for peer review. Part 1 submission must be submitted as a word processing file to allow peer revision using track changes, while the final project should be submitted as PDF by 5:00 PM on Thursday Nov 14 (EST). Late projects will be penalized at a rate of 10% per day for the Final Project's grade. The project will be divided in three parts:

Part 1. Due on October 31 by 8 PM (EST). It should contain the following sections: title, abstract, introduction (include the objectives here), material and methods, and results (do not include discussion/conclusion yet!). In the materials and methods, you should also include the experimental design, the statistical model for the analysis, and information on data collection (How/When/What measurements will be taken). Maximum 4 pages, double-spaced, 12-point text.

Part 2. Due on November 14 by 8 PM (EST). It should include all the sections presented in Part 1 in addition to the discussion, conclusion and references. Page limit for the Final Project: 5 pages (not including references). The final written document must include all sections in this order: title, abstract, introduction, material and methods, results and discussion, conclusion, and references. Double-spaced, 12-point text. .

5-minute Presentation
For the oral presentation of your project, each student will present during a 5-minute presentation in class on November 14, November 21 and 28, and December 5 (students will be assigned to those dates). The presentation format is open, and students are encouraged to use their preferred delivery method (single-slide or multiple-slide power point presentation (**but no more than 5 slides**), use of videos, pictures, diagrams, etc.). It will be presented to the whole class through Zoom and its format should follow the final project sections (title, abstract, introduction, material and methods, results, discussion, conclusion). The grade for the final project will be split in two: 7.5 points for the final written project and 7.5 points for oral presentation, totaling 15 points (maximum). The students who served as reviewers for the written part will also serve as evaluators for the oral presentation, and the instructor will provide a rubric for the evaluation. The grade will be an average of all peer-reviews and the instructor's evaluation.

Laboratory/Field visits
The laboratory and/or field visits are mandatory for On-Campus and REC students. Laboratory topics include, but are not limited to: training in R, data handling and analysis, invited speakers, and paper discussions. Field topics include field surveys, factors affecting experimental design, implementation of research experiments, research equipment, planting, labeling, data collecting, reporting results and dealing with unexpected events. We will plan two trips to the Plant Science Research and Education Unit near Citra, FL, and we will have a field trip on campus to visit greenhouse and lab settings (see course schedule). Transportation will be provided for all field trips, and Online students are required to attend all field visits.

Software
You will need to access to your own laptop during class. The main software used will be R which can be downloaded from www.r-project.org. and R-studio http://www.rstudio.com/. It is your responsibility to make sure that your computer has the latest version of R. Prior to the first day of class, please make sure you have removed all old versions of R, and have the most recent version installed. You can contact the instructor or TA's for help.

Required Literature

- Clewer, A.G. & D.H. Scarisbrick (2001). Practical Statistics and Experimental Design for Plant and Crop Science. John Wiley & Sons, Ltd.
- Assigned readings and lecture will be provided by the instructor on Canvas (https://elearning.ufl.edu).

Recommended Literature

- Glaz, B., & Yeater, K. M. (2017). Applied Statistics in Agricultural, Biological, and Environmental Sciences. American Society of Agronomy (ASA).
- Welham, S.J., S.A. Gezan, S.J. Clark, and A. Mead (2014). Statistical Methods in Biology: Design and Analysis of Experiments and Regression. Chapman and Hall/CRC Press
- Casella, G. (2008). Statistical Design. Springer Science + Business Media, LLC.
- Pearce, S.C., G.M. Clarke, G.V. Dyke, R.E. Kempson (1988). A Manual of Crop Experimentation. Oxford University Press.

There are numerous online resources available for R training. For a traditional textbook:

- Crawley, M. J. (2012). The R book. John Wiley & Sons.
- Instructor will use CANVAS discussion to provide other resources about R and statistical models.

Course schedule and topics (tentative). Chapters refer to book Clewer et al. 2001.

Week	Topic description
Wk 1	Theme: Basic Concepts of Experimentation (Chapter 1, 2, 3, 4 and 5) Day 1: Thursday Aug 22 a. Introductions, reviewing syllabus, and assessment of expectations. b. Basic concepts of experimentation. c. Review of basic statistics. d. Individual project overview. e. **Reading assignment 1 posted on Canvas.**
Wk 2	Theme: Statistics review and fundamentals of experimental design (Chapter 4, 5, and 7) Day 1: Tuesday Aug 27 a. Fundamentals of experimental design and hypothesis testing. b. **Recommended reading posted on Canvas: Data organization, storage and sharing.** Day 2: Thursday Aug 29 a. Fundamentals of experimental design and hypothesis testing (continue). b. Discussion on data organization, storage and sharing. c. Individual project: discussion on data availability for each student. d. Discussion reading assignment 1 – Breakout groups (15 min) and whole class (15 min). *e. Introduction to R and to the R companion book – Leader: Pablo Sipowicz* **f. Assign Homework #1 in Canvas** **g. Reading assignment 2 posted on Canvas**
Wk 3	Theme: Statistical models, and key assumptions of experimental designs (Chapter 14) Day 1: Tuesday Sept 3 a. Statistical models and designs b. Discussion reading assignment 2 – Breakout groups (15 min) and whole class (15 min). Day 2: Thursday Sept 5 a. Key assumptions of experimental designs c. Checking and dealing with assumption departures

	d. Introduction to GLM *e. Summary statistics data in R – Leader: Pablo Sipowicz* **f. Homework 1 is due on Canvas at 8 PM**
Wk 4	Theme: Experiments with a single factor (Chapter 9, 10, 11) Day 1: Tuesday Sept 10 a. Design of experiments with a single factor b. Review and discuss homework #1 Day 2: Thursday Sept 12 a. Analysis and interpretation of experiments with a single factor. b. Survey field equipment, discuss field and greenhouse experimentation – Buck Nelson, PSREU. c. *Data analysis for experiments with single factor in R – Leader: Pablo Sipowicz*
Wk 5	Theme: Designing experiments with Multiple Factors (Chapter 12, 16) Day 1: Tuesday Sept 17 a. Designing experiments with two factors. Day 2: Thursday Sept 19 a. Designing experiments with multiple factors. b. Factorial, Split, and Strip-plot treatment arrangements. c. *Analysis of experiments with multiple factors in R – Leader: Pablo Sipowicz* d. **Assign Homework #2**
Wk 6	Theme: Field Visit: experiment layout, visit single and multiple-factor experiments. Day 1: Tuesday Sept 24 No class because we might extend the field visit beyond normal hours on Thursday Sept 26. Day 2: Thursday Sept 26 Field visit schedule: 12:50 Leave from Building 350 1:20 Arrive to Citra Welcome from **Dr. Marcelo Wallau, Assistant Professor, Forage Extension Specialist** Experimental area layout and blocking. Research vs demonstration plots. Visit established single and multiple factor experiments. Horticultural experiments – TBA Agronomic Experiments – TBA Other areas – TBA 3:30 Return to Gainesville
Wk 7	Theme: Comparisons of Treatment Means (Chapter 13 and 14) Day 1: Tuesday Oct 1 a. Comparison of treatment means. b. Sample size calculation: Power and Replication c. Review and discuss homework #2 Day 2: Thursday Oct 3 a. Analysis and Interpretation of Interactions of Fixed and Random Effects *b. Comparison of Treatment Means for single and multiple factors in R – Leader: Pablo Sipowicz* **c. Reading assignment 3 posted in Canvas** **d. Homework 2 is due on Canvas at 8 PM**
Wk 8	Theme: Multiple-factor experiments, missing values and incomplete block designs (Chapter 15) Day 1: Tuesday Oct 8

	a. Introduction to more complex experimental designs Day 2: Thursday Oct 10 b. Demo on designing complex experimental designs c. Missing values and incomplete block designs d. Discussion reading assignment 3 – Breakout groups (15 min) and whole class (15 min). e. **Assign Homework #3: Multiple Factor Experiments**
Wk 9	Theme: Linear regression and correlation (Chapter 7) Day 1: Tuesday Oct 15 a. Linear Regression and Correlation Day 2: Thursday Oct 17 b. Linear Regression and Correlation (continues) *c. Regression Analysis and Correlation in R – Leader: Pablo Sipowicz* *d.* **Homework #3 is due on Canvas at 8 PM**
Wk 10	Theme: Greenhouse/Lab Visits: Agronomy and Entomology Greenhouse Experiments, and UF/IFAS Growth Chamber facilities Day 1: Tuesday Oct 22 No class because we might extend the field visit beyond normal hours on Thursday Oct 24. Day 2: Thursday Oct 24 Field visit schedule: Agronomy, Entomology and Plant Pathology Greenhouse Experiments 12:50 Meet in Fifield Hall Main Entrance 1:00 Dr. Billy Crow Lab and Greenhouse – Entomology and Nematology Department Check lab, greenhouse, and experimental designs. Q&A for this section. 1:30 UF/IFAS Growth Chamber Facility Mr. Brian Owens Check equipment and facility. Q&A for this section. 2:00 Agronomy Genetics and Physiology – Plant Array and Phenotyping Dr. William Hammond and Dr. Gerard Sapes Check lab, greenhouse, and experimental designs. Q&A for this section. 3:00 Agronomy Genetics and Physiology – Building 350 Dr. Rios – Designing and conducting experiments in greenhouses 3:30 Adjourn
Wk 11	Theme: Linear mixed models and artificial intelligence Day 1: Tuesday Oct 29 a. Introduction to repeated measures. b. Review and discuss homework #3 Day 2: Thursday Oct 31 a. Introduction to Linear Mixed Models and Repeated Measures. b. *Analysis of repeated measures and mixed model data in R – Leader: Pablo Sipowicz* c. **Individual Project Final Deadline due at 8 PM.**
Wk 12	Theme: Categorical data and Non-parametric Methods Day 1: Tuesday Nov 5 a. Categorical data: Analysis of counts (Chapter 18) Day 2: Thursday Nov 7 a. Non-parametric Methods (Chapter 19)

	b. *Analysis of counts and Non-parametric models in R – Leader: Pablo Sipowicz* c. **Individual Project Final Deadline due at 8 PM.**
Wk 13	Theme: Project presentations Day 1: Tuesday Nov 12 a. **NO CLASS Nov 12 due to CROP SCIENCE MEETING** b. **Individual Project Final Deadline due at 8 PM on Nov 12.** Day 2: Thursday Nov 14 c. Student project presentations (14 students)
Wk 14	Theme: Project presentations Day 1: Tuesday Nov 19 a. Student project presentations (7 students) Day 2: Thursday Nov 21 a. **Take-home exam at the same time for normal class.**
Wk 15	Theme: No class Day 1: Tuesday Nov 26 b. **No class due to Thanksgiving Holiday.** Day 2: Thursday Nov 28 c. **No class due to Thanksgiving Holiday.**
Wk 16	Theme: Project presentations Day 1: Tuesday Dec 3 a. Project presentations (7 students)

Attendance and Make-Up Work
"Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Online 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/.

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

Academic Honesty
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 assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. 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 more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

Services for Students with Disabilities
"Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565; https://disability.ufl.edu/get-started/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester."

Campus Resources
Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling& Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, **www.counseling.ufl.edu/cwc/**
- Counseling Services
- Groups and Workshops
- Outreach and Consultation
- Self-Help Library
- Wellness Coaching

U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit U Matter, We Care website to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: Visit the Counseling and Wellness Center website or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the Student Health Care Center website.

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.

GatorWell Health Promotion Services: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the GatorWell website or call 352-273-4450.

Academic Resources

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu

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.

In-Class Recording

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.

Privacy statement

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.

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, **www.dso.ufl.edu/drc/**

The instructors reserves the right to make changes in the assignments and syllabus as needed. Notification will be via E-Learning, e-mail or class announcements.