AGR 5266C Field Plot Techniques (Sections 0877 and 1933)

Graduate Level – 3 credit hours

Fall 2018

Instructor: Dr. Esteban F. Rios
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Teaching Assistants: 1- Fernanda Souza Krupek: krupek@ufl.edu
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3- Rodrigo Amadeu Rampazo: rramadeu@ufl.edu
Office Hours: TBD

Location and time: Tuesdays periods 3 and 4 (9:35-11:30 pm), McCarty B 3124
Thursday periods 3 (9:35-10:25), McCarty B 3124

Prerequisite

An introductory course in statistics: STA2023 or STA3024 or equivalent required.

Course Description

The ability to design and analyze data from experiments is fundamental to a successful research career. The course is not a theoretical statistic class; however, we will need to cover some fundamental statistical concepts during lectures. For the most part, the course will focus on applied information during classroom, labs, paper discussions and field visits. This course provides an introduction to techniques and procedures used in planning, designing, analyzing data and interpreting results in field/greenhouse/laboratory research experiments in Agricultural studies.

Intended Audience

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

Course Objectives

The broad goal for Field Plot Techniques is to instruct students on how to properly plan experiments, analyze data, and interpret results associated with testing hypotheses in agricultural research. Furthermore, I would like to familiarize students with fundamental elements of field experimentation: factors to consider when planning experiments, experimental designs use in Agricultural settings and their implementation.

At the end of the course, students are expected to have the knowledge required to design their own experiments, considering the advantages and disadvantages of the most common experimental designs in Agricultural studies, analyze their own data in R and interpret statistical results.

Expected outcomes for students taking Field Plot Techniques are:

1. You will be able to comprehend concepts required to plan experiments to test hypotheses, including experimental error, replication and randomization, and their purpose in experimental design.
2. You will learn about experimental designs used in field and greenhouse Agricultural studies: completely random design, randomized complete block design, Latin square design and different treatment arrangements used in these experimental designs: factorial and split-plot. For each design, students will learn the following topics: proper randomization procedure, how to describe the design, advantages and disadvantages for each design, partition sources of variation and degrees of freedom, write linear additive models, perform analysis of variance and Regression for each experimental design in R, make tests of significance and interpret results.
3. You will be able to apply the key concepts of field experimentation and statistics in our field visits to the Plant Science Research and Education Unit and campus greenhouses/labs.

4. You will be able to apply the key concepts of field experimentation and statistics learned during lectures, and labs, in your individual final project.
5. You will be equipped with the skills needed to choose the most appropriate experimental design to test hypotheses in Agricultural studies, layout the experiment in the field/greenhouse and choose experimental units based on equipment/tools/materials available. In addition, you will be able to create a data log, collect, handle and analyze data in R, and provide interpretation of the statistical analysis.

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 field visits. We will cover a wide range and significant quantity of material during the semester. If you have not had an introductory statistics course and/or some training in research/experimental designs, you may need to do some extra reading to aid your progress in the course. You are expected to communicate your special needs to review material covered in class during office hours with the instructor or any of the TA's.

Evaluation

Activity	Number	Points/activity	Total
Homework	3	10	30
Quizzes	4	2.5	10
Project: Part 1	1	7.5	7.5
Project: Part 2	1	7.5	7.5
Final Project and Oral Presentation	1	15	15
Participation	1	10	10
Final Exam	1	25	25
Total	**12**		**100**

Grading
A ≥ 90 B+ 85 to 89 B 80 to 84 C+ 75 to 79 C 70 to 74 D+ 65 to 69 D 60 to 64 E < 60

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, assign readings and paper discussions, etc. All homework will be related to the topics being covered in class. They will be due one week after they will be submitted through CANVAS in a PDF format. You are expected to understand the analysis process, results, and conclusions from the homework as we will discuss the homework in class. Late homework will be penalized at a rate of 10% of the homework grade per day.

Quizzes
Quizzes will happen randomly during class. They will consist of a question pertinent to the topic being discuss that day. Students are required to answer the question in a piece of paper. Student must write their complete name and UFID number in the paper, while Online students will have to email me (estebanrios@ufl.edu) their answers during the allotted time period when the quiz is assigned. 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 research projects. The final project is expected to contain a title, an introduction for the topic being investigated and a rationale for the research question or hypothesis being investigated, justification of the selected experimental design, plan to execute the design in the field or greenhouse (soil sampling, planting, fertilization, irrigation, weed management, etc.), field and equipment considerations for

establishing and conducting the experiment, data collection, R script for data analysis, and interpretation of the results. For students who are not conducting research yet, or those who do not have data available, we will provide with simulated data according to their choice of experimental design. The final project will be due on Thursday Nov 15 by 5:00 PM (EST). Project should be emailed to instructor in PDF format. Late projects will be penalized at a rate of 20% per day for the Final Project's grade. Each project section will be peer-reviewed (blind) by other students taking the class, and the instructor will assign reviewers. The peer review exercise counts for "Participation grade" points of your grade. Students will be assigned at least 2 projects for peer review.

The project will be divided in three sections:

Part 1. Due on Thursday September 27 by 5 PM (EST). It should contain the title, your name and UFID, introduction/rationale, objectives/hypothesis, and material and methods. **Material and Methods:** Emphasis should be given to the experimental design, including a justification of the chosen experimental design over other possible designs. In addition, the field or greenhouse consideration to establish the experiment and the layout of the experimental design. It should also include the statistical model for the analysis, and information on data collection (How/When/What measurements will be taken?). Maximum 2 pages, double-spaced, 12-point text.

Part 2. Due on Thursday October 18 by 5 PM (EST). It should include all the sections presented in Part 1 (included revisions provided by TA) plus an abstract, results (using graphs and/or tables), 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, discussion, conclusion and references. Double-spaced, 12-point text. The peer-reviewed evaluations will be returned to students on November 1, so they can make final changes prior to its final submission on Nov 13. Final submissions will be peer-reviewed again by the same students and returned to authors by Nov 20.

Final Written Project and 5-minute Presentation
Each student will present their final project during a 5-minute presentation in class on November 27 and 29 (students will be assigned the date later in the semester). The presentation format is open and students are encouraged to use their preferred delivery method (printed poster, single-slide or multiple-slide power point presentation (no more than 5 slides), use of videos, pictures, diagrams, etc.). It will be presented to the whole class 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. 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 software, design of experiments, data handling, analysis of data, invited speakers, reports to field visits and paper discussions. Field topics include, but are not limited to, field survey, factors affecting experimental design, implementation of research experiments, research equipment, planting, labeling, data collecting, reporting results and dealing with unexpected events in field research. We will plan three trips to the Plant Science Research and Education Unit near Citra, FL to learn about field equipment and experiments. 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 (Section 1933) are required to attend those field visits.

Software
You will need to bring your own laptop to 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 complete lecture outlines will be provided by the instructor.

Recommended Literature

- 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.
- Lenth, R.V. (2001). Some practical guidelines for effective sample size determination. The American Statistician, 55(3), 187-193.

There are numerous online resources available for R training; however, if you would like a traditional textbook, The R Book, is widely available and comprehensive.

- Crawley, M. J. (2012). The R book. John Wiley & Sons.

Course Schedule and Topics (Tentative). Chapters refer to book Clewer et al. 2001.

Topic	Description
Wk 1	Theme: Basic Concepts of Experimentation (Chapter 1, 2, 3) Day 1: Thursday Aug 23 a. Introductions, reviewing syllabus, and assessment of expectations b. Basic concepts of experimentation (starts) c. **Reading assignment 1 posted in Canvas**
Wk 2	Theme: Statistics Review and Fundamentals of Experimental Design (Chapter 4, 5, 7) Day 1: Tuesday Aug 28 a. Basic concepts of experimentation (continue) b. Review of Basic Statistics c. Paper discussion for reading assignment 1 Day 2: Thursday Aug 30 a. Fundamentals of Experimental Design
Wk 3	Theme: Field Visit: survey field equipment and data collection. Day 1: Tuesday Sept 4 Field visit schedule: 9:30 Leave from McCarty B (15-passenger Van will be parked next to the vending machines) 10:00 Arrive to Citra Welcome from **Jim Boyer (PSREU Center Director)** Survey field equipment and discuss field experimentation. Q&A for this section. 11:00 Data collection: collect visual and sensor-based data in Dr. Kenworthy's turf plots. 11:45 Return to Gainesville a. **Reading assignment 2 posted in Canvas** Day 2: Thursday Sept 6 No class because we might extend the field visit beyond normal hours on Tuesday Sept 11. You are expected to work on the reading assignment and Final Project from home during class hours.
Wk 4	Theme: Fundamentals of Experimental Design and Key Assumptions of Experimental Designs Day 1: Tuesday Sept 11 a. Fundamentals of Experimental Design (continue) b. Introduction to R software Part 1 **– Rodrigo Amadeu** c. **Assign Homework #1: Field plot techniques** Day 2: Thursday Sept 13

	a. Key Assumptions of Experimental Designs b. Paper discussion for reading assignment 2
Wk 5	Theme: Experiments with Single Factor (Chapter 9, 10, 11) Day 1: Tuesday Sept 18 - Instructor: Gurleeen Kaur a. Design of experiments with single factor b. Design of single factor experiments using different strategies c. Analysis of experiments with single factor in R – TA's lead the lab portion **d. Homework #1 is due** Day 2: Thursday Sept 20 a. Analysis and interpretation of experiments with single factor b. **Discuss homework #1**
Wk 6	Theme: Field Visit: field survey, experiment layout, soil sampling and visit single factor experiments. Day 1: Thursday Sept 25 Field visit schedule: 9:30 Leave from McCarty B (15-passenger Van will be parked next to the vending machines) 10:00 Arrive to Citra Welcome from **Dr. Marcelo Wallau, Assistant Professor, Forage Extension Specialist** Field Survey Stop 1: Dealing with slopes, seasonal flood, weed/pest control and crop rotations Stop 2: Experimental area layout, blocking and plot marking Stop 3: Soil sampling Stop 4: Visit already established single factor experiments 11:45 Return to Gainesville a. **Assign Homework #2: Single Factor Experiments** Day 2: Thursday Sept 27 No class because we might extend the field visit beyond normal hours on Tuesday Sept 25. You are expected to work on Homework #2 and the Final Project from home during class hours. **Final Project: Part 1 Due Thursday Sept 27 by 5 PM.**
Wk 7	Theme: Designing experiments with Multiple Factors (Chapter 12, 16) Day 1: Tuesday Oct 2 a. Designing experiments with two factors b. Factorial treatment arrangement c. Split-plot treatment arrangement d. Analysis of experiment with two factors in R – TA's lead the lab portion e. **Homework #2 is due** Day 2: Thursday Oct 4 a. Designing experiments with multiple factors b. Split-split, Strip-Split and other examples with multiple factors **c. Homework #2 discussion**
Wk 8	Theme: Greenhouse/Lab Visits: UF/IFAS Plant Diagnostic Center, Entomology/Plant Pathology Greenhouse Experiments and Agronomy Climate Change Greenhouse. Day 1: Tuesday Oct 9 Field visit schedule: 9:30 Meet in Fifield Hall Lobby 10:00 Arrive to the UF/IFAS Plant Diagnostic Center Welcome from Dr. Carrie Harmon (UF/IFAS Plant Diagnostic Center Director) Check lab, equipment, and facility. Q&A for this section. Methods for sampling vegetables, turf, ornamental, and agronomic crops for diseases/pests. 10:40 Arrive to Dr. TBD Greenhouse – Entomology/Plant Pathology Experiments in Greenhouse Welcome from Dr. TBD Check lab, greenhouse, and experimental designs. Q&A for this section.

	11:15 Arrive to Agronomy Genetics and Physiology – Agronomy Climate Change Greenhouse Welcome from Dr. Esteban Rios Check lab, greenhouse, and experimental designs. Q&A for this section. 11:45 Adjourn a. **Assign Homework #3: Multiple Factor Experiments** Day 2: Thursday Oct 11 No class because we might extend the field visit beyond normal hours on Tuesday Sept 11. You are expected to work on Homework #3 and the Final Project from home during class hours.
Wk 9	Theme: Comparisons of Treatment Means and Dealing with Assumptions (Chapter 13 and 14) Day 1: Tuesday Oct 16 a. Multiple Comparisons b. Sample size calculation c. Multiple comparisons with single and two factors in R – TA's lead the lab portion **d. Homework #3 is due** Day 2: Thursday Oct 18 a. Checking and dealing with assumption departures b. Data transformation c. **Homework #3 discussion** d. **Final Project: Part 2 Due Thursday Oct 18 by 5 PM.**
Wk 10	Theme: Field Visit: Multiple-factor field and greenhouse experiments Day 1: Tuesday Oct 23 Field visit schedule: 9:30 Leave from McCarty B (15-passenger Van will be parked next to the vending machines) 10:00 Arrive to Citra 10:05 Horticultural experiments – TBA 10:35 Agronomic Experiments – TBA 11:05 Other Experiments – TBA 11:45 Return to Gainesville Day 2: Thursday Oct 25 No class because we might extend the field visit beyond normal hours on Tuesday Oct 23. You are expected to work on the Final Project from home during class hours.
Wk 11	Theme: Introduction to more complex designs and analyses; and Regression and correlation (Chapter 7) Day 1: Tuesday Oct 30 a. Survey of more complex experimental designs b. Repeated measures c. Analysis of data with repeated measures in R – TA's lead the lab portion Day 2: Thursday Nov 1 (Chapter 7) a. Simple Linear Regression and Correlation b. **Final Project: Peer-reviewed project is returned to Students**
Wk 12	**NO CLASS Nov 6 and 8. CROP SCIENCE MEETING in Baltimore, MD**
Wk 13	Theme: Linear Mixed Models Day 1: Tuesday Nov 13 a. Introduction to Linear Mixed Models: **Dr. Patricio Munoz**, **Assistant Professor, Horticultural Sciences Department** b. Reading assignment 3 posted in Canvas c. **Final Project: Final submission with changes made after peer-reviewing**

	Day 2: Thursday Nov 16 d. Analysis of mixed model data in R – TA's lead the lab portion e. Paper discussion for Reading assignment 3
Wk 14	Theme: Non-traditional experimental design in plant sciences (reading TBA) Day 1: Tuesday Nov 20 a. Invited speaker: **Dr. Chris Wilson, Assistant Professor, Agronomy Department** b. Paper discussion for the assigned reading c. **Final Project: Final peer-reviewed project is returned to Students** Day 2: **NO CLASS Nov 22. Thanksgiving Holidays**
Wk 15	Theme: Project presentations Day 1: Tuesday Nov 27 a. Project presentations Day 2: Thursday Nov 30 a. Project presentations (continue) b. Class Wrap-up
Wk 16	Theme: Final Exam Day 1: Tuesday Dec 4 a. Take-home Exam

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/ugrad/current/regulations/info/attendance.aspx."

Online Course Evaluation Process
"Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/."

Academic Honesty
"UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students 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." The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honorcode/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. 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.

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

Services for Students with Disabilities

"Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) 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 Helping Resources

Health and Wellness:

U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392- 1575 so that a team member can reach out to the student.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc/Default.aspx, 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS) Student Health Care Center, 392-1161. University Police Department, 392-1111 (or 9-1-1 for emergencies). http://www.police.ufl.edu/