AGR 5266C Field Plot Techniques (Sections 0877 and 1933)
Graduate Level – 3 credit hours
Fall 2019

Instructor: Dr. Esteban F. Rios
2005 SW 23rd Street Building 350 Off. 5
352-294-3795
estebanrios@ufl.edu
Office Hours: TBD

Teaching Assistants: 1- Lesley Schumacher (PhD candidate, ENT): lesleyschumacher@ufl.edu
2- Christina Finegan (PhD candidate, HOR): cfinegan@ufl.edu
3- Rodrigo Rampazo Amadeu (PhD student, HOR): rramideu@ufl.edu
Office Hours: TBD

Location and time: Tuesdays period 7 (1:55- 2:45 pm), PSF 0005
Thursday periods 7 and 8 (1:55 - 3:50 pm), PSF 0005

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 cover some fundamental concepts to create a baseline framework for the applied statistical component. For the most part, the course will focus on how to apply statistical and agricultural concepts when designing experiments through lectures, 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. Students will demonstrate the learned concepts through graded quizzes, homeworks, a special project and a final exam. Quizzes and homeworks are reviewed in class after each deadline to provide comprehensive feedback. Besides, detailed individual feedback on the special project is given from two blind-reviewers, TA’s 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 science disciplines (e.g. agronomy, horticulture, environmental horticulture, entomology and nematology, plant pathology and forestry).

Course Objectives/Outcomes
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 experiments, analyze data in R, interpret statistical results and disseminate scientific findings using various channels (oral and written).

Upon completion of this course, students will:
1. Master the concepts required to plan and execute experiments to test hypotheses, including experimental error, replication and randomization, and their purpose in experimental design.
2. Describe 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: randomization procedures, how to describe the design, 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, make tests of significance and interpret results.
3. Apply key concepts of agricultural experimentation and statistics during our field visits to the Plant Science Research and Education Unit and campus greenhouses/labs, and demonstrate the concepts learned during quizzes, homeworks and final exam.

4. Apply key concepts of field experimentation and statistics learned during lectures, labs, homework, and paper discussion in your individual final project. You will be challenged to work on your own experiment and choose the most appropriate experimental design to test hypotheses in an agricultural study, layout the experiment in the field/greenhouse and choose experimental units based on equipment/tools/materials available. In addition, you will use your own data, or data will be simulated based on your chosen experimental design. In addition, you will analyze data in R and provide a written and oral report of your results and conclusions. Your individual project will be peer-reviewed in class and will serve as a comprehensive base for your 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 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 R or research/experimental designs, you may need to do some extra reading to aid your progress in the course (request additional reading material to the instructor). You are expected to communicate your special needs to review material covered in class during office hours with the instructor or TA’s.

Evaluation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number</th>
<th>Points/activity</th>
<th>Total</th>
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<tbody>
<tr>
<td>Homework</td>
<td>3</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Quizzes</td>
<td>4</td>
<td>2.5</td>
<td>10</td>
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<tr>
<td>Project: Part 1</td>
<td>1</td>
<td>7.5</td>
<td>7.5</td>
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<tr>
<td>Project: Part 2</td>
<td>1</td>
<td>7.5</td>
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<tr>
<td>Final Project and Oral Presentation</td>
<td>1</td>
<td>15</td>
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<tr>
<td>Participation</td>
<td>1</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Exam</td>
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<td>25</td>
<td>25</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
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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


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 being covered in class. Homeworks will be posted on CANVAS and students are required to submit answers in a PDF format. You are expected to understand the R scripts and statistical analyses, interpret results and conclusions, as we will discuss the answers in class the week after each deadlines. Late homework will be penalized at a rate of 10% of the homework’s 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. Students must write their complete name and UFID number in the paper, while Online students will have to email the instructor (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 14 by 5:00 PM (EST). The project should be emailed to the 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 (blinded) 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 22 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 24 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 October 31, so they can make final changes prior to its final submission on Nov 7. Final submissions will be peer-reviewed again by the same students and returned to authors by Nov 14.

**Final Written Project and 5-minute Presentation**
Each student will present their final project during a 5-minute presentation in class on November 19, 26 or December 3 (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](http://www.r-project.org) and R-studio [http://www.rstudio.com/](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
- Assigned readings and complete lecture outlines will be provided by the instructor.

Recommended Literature

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.


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<tr>
<th>Topic</th>
<th>Description</th>
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<tbody>
<tr>
<td>Wk 1</td>
<td>Theme: Basic Concepts of Experimentation (Chapter 1, 2, 3)</td>
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</table>
|       | Day 1: Tuesday Aug 20  
|       | a. Introductions, reviewing syllabus, and assessment of expectations  
|       | b. Basic concepts of experimentation (starts)  
|       | c. **Reading assignment 1 posted in Canvas** |
|       | Day 2: Thursday Aug 22  
|       | a. Basic concepts of experimentation (continue)  
|       | b. Review of Basic Statistics  
|       | c. Paper discussion for reading assignment 1 |

| Wk 2  | Theme: Statistics Review and Fundamentals of Experimental Design (Chapter 4, 5, 7) |
|       | Day 1: Tuesday Aug 27  
|       | a. Fundamentals of Experimental Design – **Dr. Kenneth Quesenberry** |
|       | Day 2: Thursday Aug 29  
|       | a. Introduction to R - **Rodrigo Amadeu**  
|       | b. Introduction to the R companion book – **Rodrigo Amadeu** |

| Wk 3  | Theme: Field Visit: survey field equipment and data collection. |
|       | Day 1: Thursday Sept 3  
|       | No class because we might extend the field visit beyond normal hours on Thursday Sept 5. You are expected to work on the reading assignment and Final Project from home during class hours.  
|       | **Reading assignment 2 posted in Canvas** |
|       | Day 2: Thursday Sept 5  
|       | Field visit schedule:  
|       | 1:50 Leave from McCarty B (15-passenger Van will be parked next to the vending machines)  
|       | 2:20 Arrive to Citra  
|       | Welcome from **Jim Boyer (PSREU Center Director)**  
|       | Survey field equipment and discuss field experimentation. Q&A for this section.  
|       | 3:20 Data collection: collect visual and sensor-based data in Dr. Kenworthy’s turf plots.  
<p>|       | 3:45 Return to Gainesville |</p>
<table>
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<tr>
<th>Wk 4</th>
<th>Theme: Key Assumptions of Experimental Designs (Chapter 14), Experiments with Single Factor (Chapter 9, 10, 11)</th>
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| Day 1: Tuesday Sept 10 | a. Fundamentals of Experimental Design (continue)  
b. Paper discussion for reading assignment 2  
c. **Assign Homework #1: Field plot techniques** |
| Day 2: Thursday Sept 12 | a. Key Assumptions of Experimental Designs  
b. Checking and dealing with assumption departures |

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<tr>
<th>Wk 5</th>
<th>Theme: Experiments with Single Factor (Chapter 9, 10, 11)</th>
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| Day 1: Tuesday Sept 15 | a. Design of experiments with single factor  
b. **Homework #1 is due** |
| Day 2: Thursday Sept 17 | a. Analysis and interpretation of experiments with single factor  
b. **Review and discuss homework #1**  
c. Data analysis for experiments with single factor in R – **TA’s lead the lab portion** |

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<tr>
<th>Wk 6</th>
<th>Theme: Field Visit: field survey, experiment layout, soil sampling and visit single factor experiments.</th>
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| Day 1: Thursday Sept 22 | **No class because we might extend the field visit beyond normal hours on Thursday Sept 24. You are expected to work on your Final Project from home during class hours.**  
**Assign Homework #2: Single Factor Experiments** |

Day 2: Thursday Sept 24  
Field visit schedule:  
1:50 Leave from McCarty B (15-passenger Van will be parked next to the vending machines)  
2:20 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  
3:45 Return to Gainesville  
**Deadline Final Project: Part 1 Due Tuesday Sept 22 by 5 PM.** |

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<thead>
<tr>
<th>Wk 7</th>
<th>Theme: Designing experiments with Multiple Factors (Chapter 12, 16)</th>
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| Day 1: Tuesday Oct 1 | a. Designing experiments with two factors  
b. Factorial and Split-plot treatment arrangement  
c. **Homework #2 is due** |
| Day 2: Thursday Oct 3 | a. Designing experiments with multiple factors: Split-split, Strip-Split and other examples  
b. Analysis of experiment with two factors in R – **TA’s lead the lab portion**  
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. |
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<td>Day 1: Thursday Oct 8</td>
<td><strong>No class because we might extend the field visit beyond normal hours on Thursday Oct 10. You are expected to work on your Final Project from home during class hours.</strong></td>
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<td>Day 2: Thursday Oct 10</td>
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<tr>
<td>Field visit schedule:</td>
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<td>1:50 Meet in Fifield Hall Lobby</td>
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<td>2:00 Arrive to the UF/IFAS Plant Diagnostic Center</td>
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<td>Welcome from Dr. Carrie Harmon (UF/IFAS Plant Diagnostic Center Director)</td>
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<td>Check lab, equipment, and facility. Q&amp;A for this section.</td>
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<td>Methods for sampling vegetables, turf, ornamental, and agronomic crops for diseases/pests.</td>
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<td>2:45 Arrive to Dr. TBD Greenhouse – Entomology/Plant Pathology Experiments in Greenhouse</td>
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<tr>
<td>Welcome from Dr. TBD</td>
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<tr>
<td>Check lab, greenhouse, and experimental designs. Q&amp;A for this section.</td>
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<tr>
<td>3:30 Arrive to Agronomy Genetics and Physiology – Agronomy Climate Change Greenhouse</td>
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<tr>
<td>Welcome from Dr. Esteban Rios</td>
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<tr>
<td>Check lab, greenhouse, and experimental designs. Q&amp;A for this section.</td>
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<td>4:00 Adjourn</td>
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Wk 9
Theme: Comparisons of Treatment Means and Dealing with Assumptions (Chapter 13 and 14)
Day 1: Tuesday Oct 15
  a. Multiple Comparisons
  b. Sample size calculation
Day 2: Thursday Oct 17
  a. Multiple comparisons with single and two factors in R – **TA’s lead the lab portion**
  b. Survey of more complex experimental designs

Wk 10
Theme: Field Visit: Multiple-factor field and greenhouse experiments
Day 1: Tuesday Oct 22
  No class because we might extend the field visit beyond normal hours on Thursday Oct 24. You are expected to work on your Final Project from home during class hours.
  **Assign Homework #3: Multiple Factor Experiments**
Day 1: Tuesday Oct 24
Field visit schedule:
  1:50 Leave from McCarty B (15-passenger Van will be parked next to the vending machines)
  2:20 Arrive to Citra
  Horticultural experiments – TBA
  Agronomic Experiments – TBA
  Other Experiments – TBA
  3:45 Return to Gainesville
  **Deadline Final Project: Part 2 Due Thursday Oct 24 by 5 PM.**

Wk 11
Theme: Introduction to more complex designs and analyses; and Regression and correlation (Chapter 7)
Day 1: Tuesday Oct 29
  a. Repeated measures in experimental designs and data analysis
  b. **Homework #3 is due**
Day 2: Thursday Oct 31 (Chapter 7)
  a. Simple Linear Regression and Correlation
  b. Analysis of data with repeated measures and regression in R – **TA’s lead the lab portion**
  c. **Homework #3 discussion**
    Final Project: Peer-reviewed project is returned to Students

Wk 12
Theme: Linear Mixed Models
Day 1: Tuesday Nov 5
  a. Categorical data: Analysis of counts (Chapter 18)
  b. Reading assignment 3 posted in Canvas
**Day 2: Thursday Nov 7**  
- Introduction to Linear Mixed Models: **Dr. Patricio Munoz, Assistant Professor, Hort. Sci.**  
- Paper discussion for Reading assignment 3  
- Analysis of mixed model data in R – TA’s lead the lab portion  
  *Deadline Final Project: Final project submission with changes made after peer-revisions*

**Wk 13**  
**NO CLASS Nov 12 and 14. CROP SCIENCE MEETING in San Antonio, TX**  
**November 14, Final Project: Peer-reviewed project is returned to Students**

**Wk 14**  
**Theme: Non-traditional experimental designs used in plant sciences (reading TBD)**  
**Day 1: Tuesday Nov 19**  
- Class wrap-up and Q&A for exam  
- Project presentations (7 students)  

**Day 2: Thursday Nov 21**  
**Exam in class**

**Wk 15**  
**Theme: Project presentations**  
**Day 1: Tuesday Nov 26**  
- Project presentations (9 students)  

**Day 2: Thursday Nov 28**  
- **No class due to Holidays**

**Wk 16**  
**Theme: Project presentations**  
**Day 1: Tuesday Dec 3**  
- Project presentations (9 students)

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**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 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/.

**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/sscr/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/