**BSC 5935: Design and Analysis of Ecological Studies**

**Instructor:** Professor Mark Butler

**Office/Email:** BBC Campus AC1 room 213 / mbutleri@fiu.edu

**Asst. Instructor:** Dr. Jack Butler

**Office/Email:** BBC Campus AC1 room 213 / jbutler@fiu.edu

**Office Hrs:** By appointment. This is so we can find a time convenient for all.

###### **Class Hrs & Room:** Tuesday and Thursday 5 – 6:15 PM.

**Text:** There is no required text for this class. I will make available to you various course handouts and materials.

Optional Text: "*The New Statistics with R*", 2015, by Andy Hector, Oxford Press, isbn 978-0-19-872906-8 (approximately $40 on Amazon).

**Course Description:** A course for graduate students and advanced undergraduates in the ecological sciences that focuses on the proper design, statistical methods, and nuances of both as applied to ecological research. The course requires a substantial amount of homework outside the classroom.

**Course Objectives:** At the conclusion of this course students should understand the essential components of exper­imental design, will become familiar with the common statistical techniques employed in the ecological sciences and their pit-falls, and will gain experience with analyzing such data and interpreting those results. It is strongly recommended that those interested in research continue their statistical training beyond this course. If nothing else, I hope that this course will help "... *prevent people from making fools of themselves ... by claiming that their favorite theory is substantiated by observations that do nothing of the sort." - Colquhoun*

### Computer Use: We will be using a statistical program called R to analyze data. R is a widely used, free and open-platform for statistics, graphics, and programming. R is not as simple to use as graphical user interface-based programs, but there are a lot of on-line help and tutorials in its use and I will provide you with “how to” handouts for analyses that we cover in class. The focus of this course is on proper use of statistics and experimental design in the ecological sciences - NOT on programming in R, nor do we have time for a lot of programming instruction.

You will be analyzing data using R on your own computer. If you do not own a computer, there are computer labs on campus where you can run R. You will need to download the R program from the web and will also need to download the appropriate version of "R Studio" (depending on your computer's operating system). The directions for downloading R and R Studio can be found on the handout titled "*How to Download R and R Studio Onto Your Computer*" (see class Canvas site).

R-Help Sessions: We will schedule a weekly 1 hr Zoom-based R help session in which we will go over the use of R-Studio and then the R code associated with each week’s lecture material. The Zoom sessions will be recorded and available to you via the Canvas website.

**Grading**: Your final grade will be calculated as follows:

Homework 80% (4 @ 20% each)

Independent Project 20%

**Original Work:** Students in this course may assist each other in using the R program, but may NOT help one another on the homework problems themselves.

**Attendance Policy:** Students are expected to attend class, but you are adults and there are times (e.g., conferences, illness, etc.) when one must miss class. That is OK, but it is the student's responsibility to make up any missed assignments or obtain lecture materials that were missed.

**Course Accomodation:** Students who require learning accomodations are encouraged to self-disclose disabilities with the FIU Disability Resource Center (<https://studentaffairs.fiu.edu/get-support/disability-resource-center/>), with whom Dr. Butler will work to make appropriate learning accommodations.

**Homework:** You will have four homework assignments during the semester. For each, you will ascertain the appropriate analysis, analyze the data, and interpret the results. Homework will usually be due 2 weeks after the assignment is given; approximate assignment and due dates are in the schedule below. The structure of the homework reports should follow that shown in the example homework handout available on the class website.

Late homework: 5% will be deducted from your homework grade for each day late.

**Homework Assignments**

* Homework assignments can be found in the CANVAS Module called "***Homework Assignments***".
* There you will find two types of files for each homework assignment:
  + Homework questions (pdf file)
  + Homework data sets (Excel; .xls files). Note that the homework Excel files each have multiple worksheets; each worksheet contains the data for a separate homework question.

**Independent Project**: You will employ what you learn about experimental design and statistical analyses to design, execute, analyze, and interpret the results of a small experiment that you devise.

The independent project must be completed on your own. You’ll have about 4 weeks to complete this assignment, which includes both a short **paper describing the study** and your results (see paper format details below) and an informal **oral presentation** (3-5 mins) to the class. **Presentations will be given to the entire class on the last day of class; you must submit your written reports that day too.**

The paper (approximately 5 pages single-spaced; in Word document format) should follow the standard scientific paper format: Title page, Abstract, Introduction, Methods, Results, and Discussion; however, no Literature Cited section is necessary. An ***Abstract*** summarizes the paper’s content, that is: objectives, general methodology, results, and implications (in that order). The ***Introduction*** should summarize the objectives and provide the necessary background information and rationale for the project. The ***Methods*** section describes the general methods employed in the study and in sufficient detail that the appropriateness of the procedures (especially experimental design and statistical tests) can be evaluated and, if necessary, repeated by others. The ***Results*** section should include an adequate verbal, statistical, and graphical description of the summarized and analyzed results – do not provide raw data. The ***Discussion*** section focuses on your interpretation of the results and the implications of your findings.

##### Reading Assignments: On the class Canvas site you will also find some scientific papers (pdf files) on experimental design and statistical issues in the ecological sciences that you should read to improve your understanding of experimental design and statistical issues pertinent to ecologists.

**Modifications to this Syllabus**

The instructor reserves the right to make modifications to this syllabus if the needs of the class

warrant. Students will be notified in class and/or via email or Canvas of any modifications.

**Accessibility and Accommodation**

The Disability Resource Center collaborates with students, faculty, staff, and community members

to create diverse learning environments that are usable, equitable, inclusive and sustainable. The

DRC provides FIU students with disabilities the necessary support to successfully complete their

education and participate in activities available to all students. If you have a diagnosed disability

and plan to utilize academic accommodations, please contact the Center at 305-348-3532 or visit

them at the Graham Center GC 190. Please visit our ADA Compliance webpage for information about accessibility involving the tools used in this course. For additional assistance please contact FIU's Disability Resource Center.

**Professional and Academic Integrity**

Florida International University is a community dedicated to generating and imparting knowledge

through excellent teaching and research, the rigorous and respectful exchange of ideas, and

community service. All students should respect the right of others to have an equitable opportunity

to learn and to honestly demonstrate the quality of their learning. Therefore, all students are

expected to adhere to a standard of academic conduct, which demonstrates respect for

themselves, their fellow students, and the educational mission of the University. All students are

deemed by the University to understand that if they are found responsible for academic

misconduct, they will be subject to the Academic Misconduct procedures and sanctions.

Academic Misconduct policies and procedures will be strictly enforced regarding cheating.

Anyone caught cheating will be asked to leave the class, will be given an “F” for the whole course

and a petition will be sent to Academic Affairs. NO EXCEPTIONS.

FIU is committed to eliminating sexual harassment. In accordance with the FIU Faculty Senate

guidelines, this syllabus includes a warning that any misconduct will be reported. FIU’s sexual

harassment policy is available at: http://www.fiu.edu/~eop/EOPSexH.pdf

FIU defines academic misconduct in the Student Conduct and Honor Code (Code) as, “any act

or omission by a Student, which violates the concept of academic integrity and undermines the

academic mission of the University in violation of the Code.” Code violations include, but are not

limited to: academic dishonesty, bribery, cheating, commercial use, complicity, falsification, and

plagiarism. The Code is available here: <https://studentaffairs.fiu.edu/get-support/student-conductand-academic-integrity/student-conduct-and-honor-code/index.php>

**Tentative Schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| Wk | Date | Lecture Topics | Assignments |
| 1 | 1/11  1/13 | Introduction  Descriptive statistics |  |
| 2 | 1/18  1/20 | Hypothesis testing – classical approaches Hypothesis testing – the new stuff |  |
| 3 | 1/25  1/27 | T-tests: 1-sample, Paired, & 2-sample | Homework #1 assigned |
| 4 | 2/1  2/3 | Experimental Design in Ecology  Experimental Design in Ecology |  |
| 5 | 2/8  2/10 | Experimental Design in EcologyExperimental Design in Ecology | Homework #1 due |
| 6 | 2/15  2/17 | General Linear Models (GLM) & ANOVA |  |
| 7 | 2/22  2/24 | Multiple Comparisons & Data TransformationsCompletely Crossed Designs | Homework #2 assigned |
| 8 | 3/1  3/3 | **SPRING BREAK** |  |
| 9 | 3/8  3/10 | Generalized Additive Models (GAM) | Homework #2 due |
| 10 | 3/15  3/17 | Mixed-model DesignsSplit-Plot & Repeated Measures Designs |  |
| 11 | 3/22  3/24 | Nested Designs  Analysis of Covariance (ANCOVA) | Homework #3 assigned |
| 12 | 3/29  3/31 | Multivariate Analysis of Variance (MANOVA)  Correlation & Linear Regression |  |
| 13 | 4/5  4/7 | Multiple Linear Regression  Logistic Regression | Homework #3 due |
| 14 | 4/12  4/14 | **Log-linear analyses**  Information Theory & AIC | Homework #4 assigned |
| 15 | 4/19  4/21 | Information Theory & AIC  Grad student Project Presentations | Independent Project due |
|  | 4/26 | Exam Week – NO CLASS OR FINAL EXAM | Homework #4 due |