Biostatistics & Experimental Design

EBIO 4080/6080, Spring 2018

Instructor: Dr. Renata Durães Ribeiro **Day/Time:** Tu, Th 9:30 – 10:45 am
E-mail: rduraes@tulane.edu **Class Location:** 102 Boggs (Building #15)
Office Hours and Location: 428 Boggs, Mondays 11:00-1:00, Wednesdays 9:00-11:00, or by appointment

Course Description: In this course, you will learn how to interpret statistical data in a biological context. Special emphasis will be placed on understanding the nature of data analysis for ecological experiments and experimental design. The class is designed for students who have not had prior experience with statistics.

Learning Outcomes: I expect students to demonstrate that they have attained the following capabilities, consistent with the learning outcomes for the Ecology and Evolutionary Biology major: 1) develop and critique logical arguments in ecology and evolutionary biology based upon principles and theories, 2) use a variety of resources and techniques to acquire, evaluate and communicate scientific evidence, and 3) demonstrate statistical and communication skills for careers in science and related disciplines.

Specific Aims: The specific aims of this course are for students to learn to: 1) design experiments suitable for statistical analysis, 2) choose the correct statistical test to apply to a given data set, 3) apply those tests to answer questions in ecology and evolutionary biology, and 4) interpret the meaning of their results.

Prerequisite: EBIO 1010/1115 "Diversity of Life / Laboratory" or equivalent

Textbook: Whitlock, M. C. and D. Schluter. 2015. *The Analysis of Biological Data*. (2nd Edition). Roberts and Company Publishers, Greenwood Village, Colorado, USA. (ISBN-13: 978-1-936221-48-6)

Other Materials: Powerpoint class slides, assignments, and supplemental material will be posted on the course website. Bring your textbook, a calculator, and some scratch paper to class. Laptops are helpful for class, but assignments can also be done in the campus computer labs.

Course website: The course website will be hosted on ***Canvas*** (access at tulane.instructure.com). There you will find class slides, assignments, as well as any relevant information (syllabus, important dates, grades) and supplementary materials. Slides will be posted shortly after each class, and can be found under "Assignments". However, it is paramount that you ***attend every class***, as there will be content and concepts discussed in class that may not be reflected in the posted materials.

Course Structure: This course will consist of lectures and 6 computer labs. Lectures will be used to introduce new material and labs will give you a chance to practice what you have learned in analyzing ecological and evolutionary data. We will mainly be using Excel and SPSS for data analysis, though other web-based statistical tools may be introduced as well; students are allowed, and even encouraged, to use the *R* package when working in assignments and projects, but we will not be using *R* in the classroom.

Examinations: There will be 2 midterm exams (worth 75 pts each) and one final exam (100 pts). All exams will be in class. For the final exam, ~70 pts will cover unit 3 and ~30 pts will cover the first two units. You are allowed to bring one 8.5 x 11" sheet of notes, a calculator, and your textbook to each exam.

Assignments: A total of 8 assignments (2 homework sets and 6 lab reports) will be assigned throughout the semester, each worth 25 pts. Lab reports are due 1 week after each lab. All assignments must be handed in at the beginning of class on the day they are due. For each day an assignment is late, 5 points will be automatically deducted. See Homework Guidelines below.

Projects: Students enrolled for graduate credit (EBIO 6080) will complete 2 additional projects, each worth 50 pts. Students enrolled for undergraduate credit (EBIO 4080) can opt to complete these projects as well, with the potential to earn up to 10 extra credit points per project.

Attendance: Lab and lecture attendance is required. Participation can raise a borderline grade.

Course Grades: Final grades for this course will be calculated as follows:

EBIO 4080		***EBIO 6080***	
Homework / Labs (8 x 25 pts)	200 pts. (45%)	Homework / Labs (8 x 25 pts)	200 (37%)
Midterm exams (2 x 75 pts)	150 pts. (33%)	Midterm exams (2 x 75 pts)	150 (27%)
Final exam (1)	100 pts. (22%)	Final exam (1)	100 (18%)
TOTAL POSSIBLE POINTS:	***450 pts.***	Projects (2 x 100 pts)	100 (18%)
		TOTAL POSSIBLE POINTS:	***550 pts.***

Grading: ***Deadline for any re-grade request is 1 week after the initial grading was returned to the class*** (not when you picked it up) or the last day of classes, whichever is earlier. Course grades will be determined according to the total of points received by the end of the course, according with the following scale:

		EBIO 4080	***EBIO 6080***
A	93 – 100%	416 – 450 pts.	509 – 550 pts.
A-	90 – 92%	403 – 415 pts.	492 – 508 pts.
B+	87 – 89%	389 – 402 pts.	476 – 491 pts.
B	83 – 86%	371 – 388 pts.	454 – 475 pts.
B-	80 – 82%	358 – 370 pts.	437 – 453 pts.
C+	77 – 79%	344 – 357 pts.	421 – 436 pts.
C	73 – 76%	326 – 343 pts.	399 – 420 pts.
C-	70 – 72%	313 – 325 pts.	382 – 398 pts.
D+	67 – 69%	299 – 312 pts.	366 – 381 pts.
D	63 – 66%	281 – 298 pts.	344 – 365 pts.
D-	60 – 62%	270 – 280 pts.	330 – 343 pts.
F	below 60%	< 270 pts.	< 330 pts.

Academic honesty: Cheating of any sort is completely unacceptable and will be prosecuted to the fullest extent possible under University policy. Rules governing academic dishonesty can be found at: http://www.tulane.edu/~jruscher/dept/Honor.Code.html.

Student Support: If you have a learning disability or health concern, please notify me as soon as possible and register with the ERC (Educational Resources & Counseling Center) at http://tulane.edu/studentaffairs/disability/students.cfm so that your needs can be accommodated.

Tulane University recognizes the inherent dignity of all individuals and promotes respect for all people. Tulane is committed to providing an environment free of all forms of discrimination based on race, ethnicity, creed, religion, gender, gender identity and sexual orientation, as well as all forms of sexual harassment, including sexual assault, domestic and dating violence, and stalking. If you (or someone you know) has experienced or experiences discrimination, domestic violence, sexual assault or sexual harassment, know that you are not alone. Resources and support are available. Learn more at onewave.tulane.edu. Any and all of your communications on these matters will be treated as either "Strictly Confidential" or "Mostly Confidential". Some important contacts are listed below:

Counseling & Psychological Services: (504) 314-2277
Coordinator of Violence Prevention: (504) 314-2161
Student Health Center: (504) 865-5255
Tulane University Police (TUPD): (504) 865-5911
Sexual Aggression Peer Hotline & Education: (504) 654-9543
Office of Institutional Equity: (504) 862-8083

Homework Guidelines

An automatic 3 points will be taken off for messy assignments or assignments that do not follow these guidelines:

1. Problem sets should be typed or neatly written. When appropriate, answers should be circled, boxed or highlighted. For all tables, charts and graphs, **indicate units** and **include a caption** describing the figure, so that someone who is unfamiliar with the data can understand the information you are presenting. Remember that even though SPSS and Excel can produce color output, you will most likely be printing on a black & white printer. If turning your assignment on paper, adjust your output as necessary so that your figures can be interpreted in black & white.

2. Showing your work can only benefit you. If you make an error in one step and the rest of your work is consistent and correct given the error, you will lose points only for the initial error. But, if you have not shown your work and I do not know how you arrived at your result, you are likely to lose more points.

3. For **all hypothesis tests**, please include the following:

> ***i) A statement of the hypotheses (null and alternative) you are testing.*** It is not always necessary to state the hypotheses both "in words" and mathematically, but if only a mathematical statement is included, the underlying scientific hypothesis should be clear. For example, if you are testing the hypothesis that mean length of wild and hatchery salmon are equal, against the alternative that they differ, it is not sufficient to write: H_o: $\mu_1 = \mu_2$ without specifying what μ_1 and μ_2 represent.
>
> ***ii) State the assumptions of the test you are using.***
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> ***iii) Perform the test and include your decision rule.*** For example, "Reject H_o if observed test statistic is larger than 3.21."
>
> ***iv) State your conclusion.*** "Reject Ho" or "Fail to reject Ho" is not a sufficient conclusion. Please relate your conclusion to the original biological research question. For example, "There is a statistically significant difference between the mean size of hatchery and wild salmon."

4. From my point of view, i, ii and iv are the most important components of your answer! They demonstrate your understanding of the test you are performing and its context. In most cases, your computer will perform the actual calculations.

5. When homework assignments require SPSS output, I do not want to see the results of statistical tests performed incorrectly. You may choose one of the following two approaches to presenting your SPSS results: modify output in the SPSS Output viewer to contain ONLY the information concerned with your final answer, or copy and paste that output into Microsoft Word.

REVISED* CLASS SCHEDULE – *SUBJECT TO CHANGE!!!

Week	Class #	Date	Topic	Chapters	Assignments and Reminders
1	1	Jan 16	Introduction & Types of data	1	
	2	Jan 18	**CLASS CANCELLED**		
2	3	Jan 23	Descriptive statistics	3,4	
	4	Jan 25	***Lab 1*** - Intro to SPSS, data exploration	2	
3	5	Jan 30	Random sampling & probability	5	
	6	Feb 1	Hypothesis testing	6	Lab1 report due
4	7	Feb 6	Frequency analyses 1	7	
	8	Feb 8	Frequency analyses 2	8	
5		Feb 13	***MARDI GRAS BREAK***		*No class*
	9	Feb 15	Contingency analyses	9	Homework #1 due **Feb/16*: Last day drop w/o record***
6		Feb 20	***Lab 2*** - Frequency analyses		
	10	Feb 22	The normal distribution	10	
7	11	Feb 27	**Midterm 1**		Lab2 report due
	12	Mar 1	One sample t-tests	11	
8	13	Mar 6	Two-sample t-tests	12	6080 Project1 due
	14	Mar 8	***Lab 3*** - *t*-tests	13	
9	15	Mar 13	Handling violations of assumptions	14	***Mar/14: Last day to drop***
	16	Mar 15	Experimental design 1	14	Lab3 report due
10	17	Mar 20	Experimental design 2	14	
	18	Mar 22	Analysis of variance (ANOVA)	15	
11		Mar 27	***SPRING BREAK***		*No class*
		Mar 29	***SPRING BREAK***		*No class*
12	20	Apr 3	***Lab 4*** - ANOVA		Homework #2 due
	21	Apr 5	Two-way ANOVA		
13	22	Apr 10	**Midterm 2**		Lab4 report due
	23	Apr 12	Correlation	16	
14	24	Apr 17	Linear regression	17	
	25	Apr 19	***Lab 5*** - Linear regression		6080 Project2 due
15	26	Apr 24	General linear models	18	
	27	Apr 26	***Lab 6*** - *Attack the data!*		Lab5 report due
16	28	May 1	Synthesis		
		Thursday May 10	**FINAL EXAM (2-4 PM)**		Lab6 report due