Syllabus for Stat 2480: Statistics for the Life Sciences

Instructor: Andrew Richards
Office: Cockins Hall 328A
Office Hours: Tuesdays 10-11 and 12-1
E-mail: richards.1227@osu.edu

Course meeting times and locations: MWF 3:00-3:55pm, CBEC 130

Required Text: The Analysis of Biological Data, by M. C. Whitlock and D. Schluter, 2^{nd} edition, customized for OSU, published by Bedford/Freeman/Worth. The online text can be purchased here: `https://www.vitalsource.com/custom/9781319147785`.

Software: We will use the R Statistical Software environment for this course. This software will be run via RStudio using the OnDemand services offered by the Ohio Supercomputer Center (`http://www.osc.edu`). The R software is also available in most computer labs on campus, and is free software that you can download and install on your personal machines as well (`http://www.r-project.org/`). Our Friday meetings will be devoted to class activities using R, and you will gain experience with R during these activities. However, **you should also expect to put in time outside of class doing data analysis with R.**

Website: Please visit `http://www.carmen.osu.edu/`. Carmen is used extensively for this course, so you should check daily for announcements about the class and other class material.

Course Description: Statistical methods play an important role in the analysis of data collected in the biological sciences. This course will provide an introduction to the analysis of biological data in a statistical framework. The topics covered include the definition of probability and manipulation of probabilistic quantities; the common discrete and continuous distributions used in modeling biological phenomena; experimental design; and statistical methods for testing hypotheses.

Course Goals: This course satisfies the learning goals of the GEC Data Analysis requirement. In particular, in Statistics 2480 students are expected to understand statistics and probability, comprehend mathematical methods needed to analyze statistical arguments, and recognize the importance of statistical ideas. These goals will be achieved by detailed study utilizing example data from the life sciences.

Course Objectives:

- To introduce you to methods of collecting data
  - By providing examples of methods of random sampling
  - By explaining correct procedures for designing experiments and observational studies
  - By explaining uses and misuses of sample surveys
- To enable you to use statistical tools for presentation of data and to understand presentations of data
  - By discussing when different types of graphical displays are appropriate and explaining proper methods of constructing graphical displays
  - By using appropriate summary statistics to describe the distribution of data
  - By introducing statistical terminology used to describe data and distributions

- To enable you to analyze data
  - By constructing and interpreting confidence intervals
  - By conducting and interpreting hypothesis tests
  - By using simple linear regression for bivariate data
- To enable you to understand basic probability and statistical concepts
  - By presenting and applying rules of probability
  - By study of the common discrete and continuous distribution used to model biological data
  - By discussing sampling distributions and the use of the Central Limit Theorem as the foundation of inference
- To enable you to evaluate statistical procedures and summaries
  - By discussing assumptions and conditions for analysis procedures
  - By identifying sources of bias in sampling, experiment, and survey methods
  - By discussing appropriate nature and scope of conclusions for analysis procedures
  - By discussing case studies in the life sciences

Homework: Required homework problems will be assigned for each topic covered in the course, and solutions will be submitted and graded via carmen quizzes. Note that you may attempt each quiz as many times as you like until the submission deadline, and your highest score will be recorded. Recommended problems will also be posted for additional practice, but will not be collected or graded. You need to work through homework problems on your own in a timely manner in order to perform well in the class. Homework is worth 15% of your overall grade.

Projects: The course will include a group project that will be carried out throughout the duration of the course, and will culminate in the submission of a 3-5 minute video describing the statistical analysis of a given data set for a general scientific audience. More information about the course project will be available separately. The project will account for 20% of your overall course grade, with specific project milestones each worth 5%.

Exams: There will be two in-class exams and a final exam. Statistical tables will be provided as needed. Calculators may be used on the exams, but the calculators on cell phones, PDAs, or any other communication device are NOT allowed. Please note the dates of all exams as given on the syllabus.

Formulas for use on the exams: Formula sheets will be provided for all exams. The formulas sheets will be made available prior to the exams to assist in exam preparation.

Makeup exams: If you absolutely need a makeup exam and have a valid excuse, please see me for the necessary arrangements. However, you must notify me in advance in such a situation. A make-up exam should be taken within a week of the missed exam. Exceptions to this policy will be permitted only in extreme situations such as serious injury immediately prior to an exam or severe illness requiring hospitalization.

Full credit on exam problems: You need to show your justification for or work on each exam problem. Answers without work will not receive full credit.

Course attendance policy: You are expected to attend all lectures. Formal attendance records will not be kept, however, students are responsible for all material covered in class. Office hours should not be used for instruction on material that has already been covered in class.

Final Grade: Your final course grade will be based on the following weighting of assessment components:

Exam 1 – 20%	Homework – 15%
Exam 2 – 20%	Project – 20%
Final Exam – 25%	

Grading Scale:
Grades will be assigned according to the scale below, with course components weighted as listed above.

93-100 = A
90-92.9999 = A-
87-89.9999 = B+
83-86.9999 = B
80-82.9999 = B-
77-79.9999 = C+
73-76.9999 = C
70-72.9999 = C-
67-69.9999 = D+
60-66.9999 = D
< 60 = E

Academic Misconduct: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5- 487). For additional information, see the Code of Student Conduct (`http://studentaffairs.osu.edu/info_for_students/csc.asp`).

In particular, please note that although students are encouraged to work together on lab assignments and homework, all students must submit their own written work IN THEIR OWN WORDS.

E-mail Correspondence: In order to protect your privacy, all course e-mail correspondence must be done through a valid OSU name.nn account. If you have not activated your OSU email account, you can activate your account at `https://acctmgt.service.ohio-state.edu/cgi-bin/KRB1EntryAdd`.

Special Accommodations: Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; `http://www.ods.ohio-state.edu/`.

Tentative Lecture and Lab Schedule

Lecture No.	Date	Topic	Textbook Readings
1	8/21/19	Introduction, methods for summarizing data	Ch. 1 - 3
2	8/23/19	Intro to the R software	
3	8/26/19	Probability	5.1 - 5.3
4	8/28/19	Probability	5.5 - 5.6
5	8/30/19	Exploratory data analysis in R *Group project check-in #1*	
No class	9/2/19	**Labor Day Holiday**	
6	9/4/19	Conditional probability	5.7
7	9/5/19	Random sampling activity	
8	9/9/19	Law of total probability, Bayes Theorem	5.8 - 5.9
9	9/11/19	Random variables	5.4
10	9/13/19	Statistical distributions in R	
11	9/16/19	Hypothesis testing, Binomial test	Ch. 6, 7.2
12	9/18/19	χ^2 goodness-of-fit test	8.2 - 8.5
13	9/20/19	Hypothesis tests in R	
14	9/23/19	Poisson distribution	8.6
15	9/25/19	**EXAM 1**	Ch. 1 - 8
16	9/27/19	*Group project check-in #2*	
17	9/30/19	Analyzing proportions, odds ratios	9.1 - 9.3
18	10/2/19	Contingency tables	9.4
19	10/4/19	Contingency tables in R	
20	10/7/19	Normal distribution	10.1 - 10.4
21	10/9/19	Central limit theorem	10.5 - 10.6
No Class	10/11/19	**Fall Break**	
22	10/15/19	t distribution and confidence intervals	11.1 - 11.2
23	10/17/19	One-sample t-test	11.3 - 11.4
24	10/19/19	Normal probability plots, t distribution	
25	10/21/19	Comparing two means, paired test	12.1 - 12.2
26	10/23/19	Comparing two means, unpaired test	12.3 - 12.7
27	10/25/19	Inference for the population mean in R	
28	10/28/19	Review for Exam 2	
29	10/30/19	**EXAM 2**	Ch. 9 - 12
30	11/1/19	*Group project check-in #3*	

31	11/4/19	Experimental and observational studies	Ch. 14
32	11/6/19	ANOVA	15.1 - 15.2
33	11/8/19	ANOVA in R (part 1)	
No class	11/11/19	**Veteran's Day**	
34	11/13/19	ANOVA	15.3 - 15.4
35	11/15/19	ANOVA in R (part 2)	
36	11/18/19	Case study	
37	11/20/19	Correlation	Ch. 16
38	11/22/19	Correlation activity in R	
39	11/25/19	Regression	17.1 - 17.2
No class	11/27/19	**Thanksgiving**	
No class	11/29/19	**Thanksgiving**	
40	12/2/19	Regression	17.3 - 17.5
41	12/4/19	Course summary & review	All material

FINAL EXAM: Monday, December 9, 6:00-7:45pm in Hitchcock Hall room 35