BI 460 Biostatistics

Term: Spring 2010	**Days**: Tues & Thurs
Room: Henry 124	**Time**: 9:30 – 10:50 PM
Credit: 3 semester hours	**Phone**: x543
Instructor: Michael Dohm	**E-mail**: mdohm@chaminade.edu
Office: Henry 6	**Office Hours**: Monday, 2-4PM or by appointment

Required text: *An Introduction to Biostatistics* 2nd edition, by Thomas Glover and Kevin Mitchell, published in 2008 by Waveland Press (ISBN 1577665805). Additional instructional material will be provided by the instructor.

Other texts (recommended but not required).

- Zar, J. 1999. *Biostatistical Analysis*, 4th edition, Prentice Hall Press (ISBN 0131008463).
- Sokal, R. R., and F. J. Rohlf. 1996. *Biometry*, 3rd edition, W. H. Freeman (ISBN 0716724111).
- StatSoft, Inc. 2010. *Electronic Statistics Textbook*. Tulsa, OK: StatSoft. WEB: http://www.statsoft.com/textbook/.

Course Description.
Biostatistics is a lecture plus hands-on course designed to provide students with the opportunity to develop statistical reasoning skills appropriate for biology. Statistical reasoning may be defined as the ability to understand and use probability arguments and to recognize the distinction between specific and generalized conclusions. After an introduction to data sets and the three philosophical positions of statistical hypotheses (frequentist, likelihood, and Bayesian), students will learn to apply statistical reasoning to questions about biological processes. Students will learn about error concepts and to identify and estimate via experimental design or simulation impacts of experimental versus biological sources of error on conclusions. Students will move from descriptive statistics and issues of parameter estimation to factorial experimental design (ANOVA, contingency tables), and general linear and logit models, all with examples and problem sets from biology.

Learning Outcomes.
During the semester, students will be given an introduction to (1) statistical tools and approaches used in biological and biomedical research, and (2) experimental design and analysis. At the conclusion of the course, students will be able to demonstrate:

1. Knowledge of data presentation through use of summary tables, bar charts, and scatter plots.
2. Ability to identify and distinguish between data types, variables, and parameters and provide examples from biology.
3. The ability to choose among kinds of statistical tests based on data types.
4. Knowledge of the difference between description and hypothesis testing.
5. The ability to present experimental design and data gathering approaches to test hypotheses on a problem in biology.

Course Requirements.
Homework: There will be seven (7) short assignments that will help you understand concepts that we cover in class. Assignments include analyzing data relevant to lecture topics and writing short reports that include presenting experimental designs, methods and statistical results using tables and graphs. You may work together on homework, but each student must turn in their

own homework. Your textbook also has many nice problems to work on: I will recommend many, but will not grade work from the text book. Of course, the more you do, the better your understanding will be!

Small Group Project: Groups of 2 students will design a project of interest in the biological sciences. The project must include the following elements: experimental design, data collection, data analysis, and conclusions. There are four graded elements:

- **Proposal**: A brief description of your project, hypotheses, and how you will approach testing the hypotheses. You will turn this in twice: a draft, then a final version which adopts and addresses my suggestions.
- **Experimental Design**: Detailed presentation of kinds of observations to be made, how they will be made, treatment groups, sample size (power), sampling scheme, statistical model. You will turn this in twice: a draft, then a final version which adopts and addresses my suggestions.
- **Final Report (oral)**: Student groups will present the report to the class at the end of the semester (last week of class). As a group, students will take 10 minutes of class time to present the results of their project.
- **Final Written Report (individual)**: Each student will also submit a final, written manuscript that follows standard scientific journal format. The report is done in collaboration with the student's group, but each student must turn in their own paper, written only by the student.

Exams: Four exams:

Exam I will cover material from weeks 1-4.
Exam II will cover material from weeks 6-8.
Exam III will cover material from weeks 10-13.
Final Exam, cumulative (70%), plus cover material from week 15 (30%).

The exams will focus on your understanding of important concepts, your ability to evaluate experimental designs, and your ability to recognize appropriate statistics to be employed given sets of data or particular experimental designs.

Class Participation: You are expected to come to class prepared, to participate fully in class by asking questions, bringing attention to media announcements of relevance to biostatistics, by helping in data collection needed for homework projects. I also encourage all of you to assist fellow students with computer and statistical software-related questions.

Grading

Item	How many?	How often may I expect this item?	How many points is each item worth?	*Total points from this item towards my final grade*
Homework	7	every 2 weeks	15	*105*
Section Exams	3	every 4-5 weeks	80	*240*
Cumulative final	1	Scheduled Exam time	120	*120*
Group Projects				*105*
Proposal			20	
Experimental Design			40	
Oral Report			20	
Written Report			40	
Discussion participation & Attendance	A lot!	daily	varies	*30*

Final grade: Your letter grade will be based on the following point distribution.

Points earned	Percent of total	Letter grade
540 – 600	90 – 100%	A
480 – 539	80 – 89%	B
420 – 479	70 – 79%	C
360 – 419	60 – 69%	D
≤ 359	≤ 60%	F

Bonus points -- Yes, there will be opportunities to earn a few bonus points from time to time up to a total of 1% of total available points, at my discretion.

Reminders and notices:

1. Class begins each time exactly at 9:30AM – please be on time. Regular attendance is expected and essential for your progress in this class. The goal of lecture and discussion will be to provide the needed context to remove barriers to your understanding of the material. We will be using a statistics software package that will be intimidating at first -- going it alone is not recommended.
2. Class ends at 10:50AM -- please refrain from asking how long class will be.
3. Please show respect to your fellow classmates: turn off cell phones and other electronic devices during class. No food or drink in Henry Hall 124.
4. No make up quiz or exam will be granted in the event of an absence. If a student cannot attend a class in which a quiz has been scheduled, the student must notify the instructor no later than the class prior to the scheduled quiz. For example, if a quiz is scheduled for Thursday, then student must approach and receive permission for the absence no later than the prior Tuesday class. In the event of illness, a Doctor's note will be expected.
5. You are encouraged to work together; however, all graded material must be your own. You are also expected to have read and to abide by the "Student Rules of Conduct" which are available in your copy of Chaminade University's Student Handbook.
6. Regarding ADA accommodations for extra time or other accommodations on exams and quizzes; Please be aware that I can only accommodate your requests if you have a documented ADA agreement with Chaminade University on file at the Counseling Center. If you need to seek such accommodations, please contact Dr. June Yasuhara at 725-4845 or by e-mail at jyasuhar@chaminade.edu as soon as possible.

Tentative BI460 Schedule, subject to change at discretion of instructor

Week	Topic or Item due	Reading
1 Jan 12, 14	Syllabus, introduction to course policies, keys to success. **Lecture**: Why statistics is important in biology. Data, samples, populations, and an introduction to probability. **Computer exercises**: Use of computers to manage research projects (databases, spreadsheets, statistical packages); resources available (free software, help with particular packages, shortcuts). Groups assigned for projects Schedule group meetings with instructor to propose project	Ch 1
2 Jan 19, 21	**Lecture**: Thinking about experiments in biology. How do interesting questions move between the lab, the field, the stages of analysis, towards an understanding of biology? **Computer exercises**: Introduction to R Statistical Language; Summary statistics and graphical display. **Homework 1 assigned.** **Draft of Project Proposals due by 5 PM**	Ch1, Ch3
3 Jan 26, 28	**Lecture**: hypothesis testing, error rates, with examples of how risk analysis instructs decision-based biology research (e.g., how to interpret results of a diagnostic test in the Doctor's office; how to interpret outcomes from a fence-exclusion project in ecological restoration). **Computer exercise**: Normal distribution and proportions of a curve; sampling distributions **Homework 1: due at start of class, 28 January** **Project proposal rewrites due by 5PM, 28 January** **Draft project implementation plan due by 5PM, 28 January**	Ch4, Ch5
4 Feb 2, 4	**Lecture**: parametric one and two sample tests, T-tests as special cases of a general approach (GLM); Nonparametric alternatives and additional discussion of statistical assumptions, violations of assumptions, and how they affect conclusions of statistical tests. **Computer exercise**: one and two sample t-tests; testing assumptions; Wilcoxon, Mann-Whitney tests. **Meeting with instructor over proposed project implementation** **Homework 2 assigned, 2 February.**	Ch5, Ch6, Ch7
5 Feb 9, 11	**Project implementation plan due** **Homework 2 due at start of class, 9 February.** **Review in class, 9 February** **Exam 1 in class, 11 February**	
6 Feb 16, 18	**Lecture**: Goodness of fit and contingency table chi-square (crosstabs); Fisher Exact test; modifications to chi-square tests **Computer exercise:** Chi-square, Fisher exact test **Homework 3 assigned, 16 February** **Project data collection begins**	Ch11
7 Feb 23, 25	**Lecture**: Correlation, simple linear regression, fit statistics **Computer exercise**: regression and correlation. **Homework 3: due at start of class, 23 February** **Project data collection continues** **Meeting with instructor over data collection progress**	Ch11

Schedule continued

Week	Topic or Item due	Reading
8 Mar 2, 4	**Lecture**: Multiple linear regression: Stepwise selection; fit statistics and influence. **Computer exercise**: multiple regression. **Special topic:** Report write-ups: Scientific writing; How to present results of experiments in papers and talks **Homework 4 assigned, 2 March**	Ch11
9 Mar 9, 11	**Homework 4 due at start of class, 9 March** **Review in class, 9 March** **Exam 2 in class, 11 March**	
10 Mar 16, 18	**Lecture**: one-way ANOVA; one-way ANOVA with covariate; posthoc tests; relationship between ANOVA and regression (GLM) **Computer exercise**: The general linear model (GLM) **Homework 5 assigned** Preliminary project data analysis Project data collection continues Draft of manuscript outline due	Ch9 Ch10
11 Mar 22-26	***Spring Break***	
12 Mar 30 Apr 1	**Lecture**: two-way crossed, balanced ANOVA, other two way ANOVA designs; nested, repeated measures; split plot **Computer exercise**: more with GLM **Homework 5 due at start of class, 30 March** **Homework 6 assigned** Preliminary project data analysis Project data collection completed Draft of Materials and Methods due by 5PM, 1 April	Ch 9 Ch10
13 Apr 6, 8	**Lecture**: GLM continued **Computer exercise:** more with GLM **Homework 6: due at start of class, 8 April** Project data analysis continues Draft of Results due by 5PM, 8 April	Assigned readings provided by instructor
14 Apr 13, 15	**Review in class, 13 April** **Exam 3, in class, 15 April** Project data analysis continues	
15 Apr 20, 22	**Lecture**: Clinical trials, risk analysis and the logistic regression extension to crosstab experimental designs. **Computer exercise**: binary and nominal logistic regression. **Homework 7 assigned 20 April** Work on project report presentations **Draft of entire paper due at start of class 22 April**	Assigned readings provided by instructor
16 Apr 27, 29	**27 April, Project oral reports & presentations** **27 April, Written report due** **Homework 7 due at start of 29 April** **29 April, Review and course wrap-up**	
17	**Cumulative Final Exam** 3 May 8-10AM	