BIOL 417: Quantitative Methods in the Biological Sciences

Spring 2011

Course Syllabus

Instructor: Dr. Paul Brunkow

Office: SL 3306 Office Hours: By Appointment

Phone: 650-2976

E-mail: pbrunko@siue.edu Laboratory: 4th Floor (650-3923)

Items Needed for this Course

- Textbook: The Analysis of Biological Data (Whitlock and Schluter, 2009)
- Flash drive to back-up homework, datasets, etc.
- Download and install MYSTAT statistical software
- Active SIUE mainframe access account
- Swiss Bank Account (with online access and $50,000 balance)

Introduction

- This course is designed to introduce you to the basic concepts and techniques underlying statistical analysis of data in a biological context. In the way I teach this course, extensive previous experience with statistics is not strictly required, although it would be quite useful. For those of you with previous statistical experience, you may find elements of this course redundant; I am certainly willing to discuss extensions of familiar topics with you, but my primary concern will be with making sure that everyone is "on the same page." I already know there is a great deal of variation in statistical background among students registered in the course; those of you with less be sure to ruthlessly exploit those with more (but not in a French-Revolutionistic, "off-with-their-heads" sort of way).

- Do not apply any math phobia you might have to this course. I do not take a rigorously mathematical approach to this course, but you will be expected to accomplish some algebraic gymnastics in order to complete assignments, to answer exam questions, and to understand concepts in more detail. "Statistics" is, in my view, very much a combination of concept and method, and the math we do encounter is meant to motivate understanding of both. You will not need to memorize any formulae (ugly or otherwise), but you will need to know how to manipulate them and to understand what they do and do not tell you.

- This will be a computer-intensive course. Data entry and management will be completed in spreadsheets (through Excel), and analyses will be performed using a statistics package (MYSTAT, the free version of SYSTAT). Again, previous experience with spreadsheets is not required, but would be helpful; no previous experience with a

statistics package is required or assumed. I will assume familiarity with the Windows operating environment (e.g., opening and closing programs, saving files, navigating between windows and subdirectories, cutting-and-pasting, etc.). Be sure to approach me early if you have concerns about this.

Course Objectives

- **μ** Introduce you to the concepts and methods underlying statistical analysis in a biological context.
- **σ** Develop your understanding of scientific hypothesis-testing in a rigorous, statistical framework.
- **ρ** Develop your skill at recognizing when particular analytical techniques should be used.
- **α** Increase your familiarity with the use of computer software in the cataloging, analysis, and presentation of scientific data.

Grading, and notes about my style of instruction

Grading:

There will be 650 points possible during this course: three lecture exams at 100 points each, a pseudo-cumulative final exam on the final exam date at 150 points, and the average score on all homework assignments to be worth 200 points. Lecture exam dates are shown in the syllabus; if they need to be changed because of shifts in the timing of lectures, you will be notified well ahead of time. ***Homework assignments will be due at the beginning of lab on the Tuesday after they are assigned in the previous Tuesday laboratory; 10% of points will be deducted from an assignment per day late, starting with that Tuesday after lab begins.*** No credit will be given for an assignment that is more than 4 days late (i.e., after that Friday afternoon); you may not e-mail assignments to me for credit.

You will be graded initially on a fixed scale: 90% - 100 % of 650 points = A, 80% - 89% = B, 70 - 79% = C, 60 - 69% = D, < 60% = F. I will curve grades if necessary, but I do not curve grades formally until all points have been awarded (i.e., until the end of the semester). I will provide information on intermediate curves throughout the semester so that you know where you stand. I do not curve down; if you earn 81% of the points, you will earn a B regardless of what everyone else does in the course. *Retain all graded materials that are returned to you.*

Attendance/Participation:

Attendance in lecture is not absolutely required, but strongly advised. You will be responsible for *everything* discussed in lecture regardless of its nature (e.g., information not present in any readings, handouts, changes in test dates, etc.). Attendance in lab is required; missing more than two labs will jeopardize your future in the course. Not only will additional lecture material be presented as part of the laboratories, but you will also receive your homework assignments and information on how to complete them in the laboratory. Some laboratory exercises in data collection and analysis will require active participation by

all present, and such participation (or lack thereof) will be duly noted and may influence grades in marginal cases. Do not come to lectures or the laboratory late!

Notes on My Style of Instruction:

I am not a detail freak, but this is a course that relies on subtle details in terms of conceptual understanding as well as methodology. I am more interested in having you understand broad concepts and applications of statistics rather than the hidden details of, say, how many commas there are on page 271 of the text. Recognize, however, that I will frequently assess your conceptual understanding through detail-oriented "busy-work" on assignments and exams. Be sure to listen to what I am saying during lecture and lab; don't simply write down what I put on the overhead and figure you'll review it later. And take notes on what I say rather than only what is written on overheads or handouts; I frequently make important points verbally that I never write down.

I typically operate under a fairly simple grading rule: your grade is your business. Recognize that grades are a reflection of achievement, not of effort. I do not *give* you a grade; rather, you *earn* a particular grade. I consider myself to be a very fair test-writer and grader. If you perform below your expectations on a particular exam or assignment, I will not entertain the notion that this is somehow my fault. *However*, that being said, I am fully cognizant that I *am* human and that I *can* (and admittedly sometimes *do*) make logistical and/or judgment errors in grading. I am very willing to address any such errors as long as they are brought to my attention in a timely fashion. I am also interested in having all students perform as well as they can in this class. I encourage you to ask questions during lecture and lab exercises, come to my office hours, make appointments to see me and ask questions, use e-mail to contact me and ask questions, and work together with your colleagues in this class as much as you can.

Academic Dishonesty

We're supposed to put a section on academic dishonesty into our syllabi. I operate on the assumption that you guys all know what it means (don't cheat, don't plagiarize, maintain an atmosphere conducive to learning by all, etc.). If you don't know what it means, you are responsible for finding that out; visit the Student Academic Code policy at http://www.siue.edu/policies/3c2.shtml, and visit the Plagiarism policy at http://www.siue.edu/policies/1i6.shtml. You are subject to these policies by virtue of being enrolled in this course. 'Nuff said.

Tentative Lecture Schedule (subject to… no…. quite likely to change)

Date	Topics	Reading (pg numbers)
01/10	Introduction and Intuition	Ch. 1
01/12	Basic definitions; Types of data; Basic notations	Ch. 3
01/14	Basic descriptive stats	
01/17	No class	No class
01/19	Basic descriptive stats; Intro to standard error	Ch. 4 (83-90, 92-93)
01/21	Probability	Ch. 5 (99-111, 115-120)
01/24	Probability	
01/26	Probability; Binomial Distribution	Ch. 7 (151-157)
01/28	Binomial Distribution; Hypothesis Testing	Ch. 6
01/31	Hypothesis testing	
02/02	Type I/Type II errors; statistical power	Handouts
02/04	Decision rules; steps to testing H_o	
02/07	**Exam #1 in Lecture**	
02/09	χ^2 distribution: goodness-of-fit tests	Ch. 8
02/11	Poisson distribution	
02/14	Contingency tests	Ch. 9 (213-221)
02/16	Contingency tests	
02/18	Normal distribution	Ch. 10 (231-247, 250-255)
02/21	Normal distribution; Central limit theorem	
02/23	t-Distribution; Confidence intervals about $\overline{Y}$	Ch. 11 (259-263; 263-271 + 90-92)
02/25	One sample t-test; confidence interval for s^2	Ch. 11 (271-275)
02/28	Comparing two means: paired vs. two-sample **(E2 tom.!)**	Ch 12 (279-293, 299-303)
03/02	Tests involving variances (χ^2 and F)	
03/04	Intro to ANOVA: Partitioning variation	Ch. 15
03/07	ANOVA: Developing table and F-test	
03/09	Spring Break	Dark and Somber Mystery
03/11	Spring Break	New Age Self-Actualization
03/14	Spring Break	Light Hearted Romance
03/16	ANOVA: Post-hoc comparisons	
03/18	ANOVA: Assumptions	
03/21	Correlation analysis	Ch. 16 (431-443, 448-451)
03/23	Correlation: Hypothesis test about ρ	
03/25	Correlation: Considerations	
03/28	Linear regression: Finding best-fit line	Ch. 17 (463-480, 482-487, 493-497)
03/30	Regression: Confidence intervals and bands	
04/01	Regression: Two ways to test H_o	
04/04	Regression: Assumptions and transformations **(E3 tom.!)**	
04/06	Two-way ANOVA: Developing model	Ch. 18
04/08	Two-way ANOVA: Tests of hypotheses	
04/11	Two-way ANOVA: Tests of hypotheses	
04/13	Randomized block ANOVA	
04/15	Multiple regression	Ch. 18, Handouts
04/18	Multiple regression	

04/20	Non-parametrics: t-test alternatives	Ch. 13 (333-343)
04/22	Non-parametrics: ANOVA alternative	Ch. 15 (404), Handouts
04/25	Non-parametrics: Correlation alternative	Ch. 16 (443-447)
04/27		
04/29		

FINAL EXAM: Wednesday May 4, 10:00 – 11:40 am