Biometrics (Bio 167)

Lecture  TTH: 3:00-3:50 pm ~ SQU 326
Lab     W: 2 – 4:50 ~ MND 2003

Instructor: Dr. Jamie Kneitel;  Office: SQU 404;  Phone: 278-3633
Email: kneitel@csus.edu;  Office hours: Wed. 2 pm, or by appointment
Course website: http://www.csus.edu/indiv/k/kneitel/Teaching.htm

Course Description
This course is designed to provide you with a basic understanding of the “doing of science” from inception of hypotheses to the presentation of the research project. This will include the development of a hypothesis and a study to test it (including the collection of appropriate data), as well as data management, presentation, and analysis. This is a class about thinking, not memorizing! You will be learning statistical tools to turn a complicated biological world into a simpler and interpretable world.

Objectives
- Provide you with basic statistical principles and tools
- Examine how different types of data can be collected and analyzed, giving you a foundation for a future career in the biological sciences
- Stimulate interest and appreciation for Statistics…really.

Expectations:
- Students are expected to attend lectures and lab. Remember, tests and quizzes will be primarily based on material presented in class. In addition, lab assignments are due the day of the lab typically
- Assigned readings are meant to be completed prior to class.

Grading:
(A) A midterm and final will be given. These will both be take-home exams.  
***Midterm: 20%, Final Exam: 20%
(B) Article evaluation will be due by October 26 (in lab). Find an article in a peer-reviewed journal, such as American Naturalist, Conservation Biology, Ecology, Oikos, Oecologia, American Journal of Botany, or a journal on your area of interest. See me for other possibilities. **Note: Your article must be approved by the instructor.** The article must be a research study that has been published within the last 5 years. Your evaluation should be typed and at least 1 page in length, but no longer than 5 pages. We will also have a group discussion regarding our findings. ***Paper Evaluation: 10%
(C) Final paper and presentation will be due at the end of the semester (December 1), presenting a data-based study. Students are welcome to turn in rough drafts prior to November 15 for critique and feedback. This final paper should be in the research article format. Options for the collection of data include develop and implement your own study, utilize published data, or I can provide you with a data set. During the course of the semester, it is your job to statistically analyze data in an appropriate manner and research the topic extensively in order to write an Introduction and Discussion. Each student will also present their findings at the end of the semester with a 10 minute talk. Details regarding this project are below.***Final Paper and Presentation: 20%
(D) Homework: 10%
(E) Quizzes: 10%
(F) Lab Assignments: 10%

****It is recommended/required that you purchase a flash drive or ZIP disc to save all of your class assignments and projects.

Tentative Course Syllabus
(dates and topics may be changed at any time)

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture Topic</th>
<th>Lab Topic</th>
<th>Reading*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/29</td>
<td>Introduction to Class, Scientific Method</td>
<td>Excel, SPSS</td>
<td>M:1,2</td>
</tr>
<tr>
<td></td>
<td>9/1</td>
<td>Flow charts/scientific questions</td>
<td></td>
<td>M: 2, H:1</td>
</tr>
<tr>
<td>2</td>
<td>9/6</td>
<td>Sampling, variables, data</td>
<td>Data organization, graphs</td>
<td>H:2</td>
</tr>
<tr>
<td></td>
<td>9/8</td>
<td><strong>No Lecture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9/13</td>
<td>Measures of central tendency</td>
<td><strong>Quiz; Descriptive Stats/Probability</strong></td>
<td>M:3, H:3,4</td>
</tr>
<tr>
<td></td>
<td>9/15</td>
<td>Probability</td>
<td></td>
<td>M:3</td>
</tr>
<tr>
<td>4</td>
<td>9/20</td>
<td>Distributions</td>
<td>Writing research articles; Platt 1964 discussion</td>
<td>M:4, H:6,7</td>
</tr>
<tr>
<td></td>
<td>9/22</td>
<td>Experimental design</td>
<td></td>
<td>M:4</td>
</tr>
<tr>
<td>5</td>
<td>9/27</td>
<td>Experimental design</td>
<td><strong>Quiz; Hurlbert 1984 discussion</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9/29</td>
<td>Statistical inference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10/4</td>
<td>Categorical data analysis</td>
<td>Categorical data analysis</td>
<td>H:14</td>
</tr>
<tr>
<td></td>
<td>10/6</td>
<td>Categorical data analysis</td>
<td></td>
<td>H:14</td>
</tr>
<tr>
<td>7</td>
<td>10/11</td>
<td>Differences between means</td>
<td>Differences between means</td>
<td>M:9, H: 9</td>
</tr>
<tr>
<td></td>
<td>10/13</td>
<td><strong>No Lecture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10/18</td>
<td>t-tests</td>
<td>ANOVA</td>
<td>M:9, H: 9</td>
</tr>
<tr>
<td></td>
<td>10/20</td>
<td>ANOVA</td>
<td></td>
<td>M:5, H: 10,11</td>
</tr>
<tr>
<td>9</td>
<td>10/25</td>
<td>ANOVA</td>
<td><strong>Article Assessment due-discussion</strong></td>
<td>M:6, H: 10,11</td>
</tr>
<tr>
<td></td>
<td>10/27</td>
<td>Correlation</td>
<td></td>
<td>M:6, H: 13</td>
</tr>
<tr>
<td>10</td>
<td>11/1</td>
<td>Correlation</td>
<td><strong>Quiz; Correlation</strong></td>
<td>M:7, H: 13</td>
</tr>
<tr>
<td></td>
<td>11/3</td>
<td>MIDTERM</td>
<td></td>
<td>M:7</td>
</tr>
<tr>
<td>11</td>
<td>11/8</td>
<td>MIDTERM DUE</td>
<td>Regression</td>
<td>M:7</td>
</tr>
<tr>
<td></td>
<td>11/10</td>
<td>Regression</td>
<td></td>
<td>M:7, H: 12</td>
</tr>
<tr>
<td>12</td>
<td>11/15</td>
<td>Regression</td>
<td>WORK ON PROJECTS</td>
<td>M:7,H: 13</td>
</tr>
<tr>
<td></td>
<td>11/17</td>
<td>ANCOVA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>11/22</td>
<td>Multivariate Stats</td>
<td>No Lab this week- WORK ON PROJECTS</td>
<td>M:7</td>
</tr>
<tr>
<td></td>
<td>11/24</td>
<td>Thanksgiving- No class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>11/29</td>
<td>Multivariate Stats</td>
<td>Presentations (part 1)</td>
<td>M:8</td>
</tr>
<tr>
<td></td>
<td>12/1</td>
<td>Special topics</td>
<td>Final Paper due December 1</td>
<td>M:8</td>
</tr>
<tr>
<td>15</td>
<td>12/6</td>
<td>Special topics- <strong>FINAL PASSED OUT</strong></td>
<td>Presentations (part 2)</td>
<td>M:8</td>
</tr>
<tr>
<td></td>
<td>12/13</td>
<td><strong>FINAL DUE</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*As of the printing of the syllabus Introductory Biological Statistics has not arrived. Since this is a new edition, I will insert chapter readings when it arrives.

So, you want to do well in this class? Here are some hints:

- Do all of the assigned homework promptly. The material on my exams is a fair representation of the assigned homework and the material covered in class.
- Do not slouch off in the beginning of the semester with the hopes of catching up later in the semester. The material in this course entails developing a cumulative set of knowledge; if you fail to grasp the material in the first half of the semester, you will struggle in grasping the second half of the material.
- A good way to study for a statistics exam is to go back and re-do all of the assigned homework. If you do not understand a particular topic, seek help before the exam.
- Practice is key.
- Attend class regularly.
- Read and follow directions carefully!
- SEEK HELP FROM ME IF YOU DO NOT UNDERSTAND A TOPIC!

Missed quizzes and late homework
Other than circumstances that are beyond your control, you cannot make up a lab quiz. Lab quizzes and assignments are designed as a way of receiving points for attending lab. If you know you cannot attend a lab, you must notify me in advance; I can email you the lab assignment to be conducted on your own time in the computer lab. Since homework will be given out on Wednesdays to be turned in on Mondays, it is your responsibility to email me and request the homework if you miss a Wednesday class. Late homework and lab assignments will be accepted, but graded down 10% of the full point value per day late.

Classroom behavior and academic honesty
I expect that all students in my class will exhibit appropriate and respectful behavior and adhere to the university's policy on academic honesty. Cheating and plagiarism will not be tolerated and will be severely punished. University policy on academic honesty clearly defines what constitutes cheating and plagiarism. Because many students are not familiar with what exactly constitutes plagiarism, the university defines plagiarism as: “the use of distinctive ideas or works belonging to another person without providing adequate acknowledgement of that person's contribution.” The university further states that “Regardless of the means of appropriation, incorporating another's work into one's own requires adequate identification and acknowledgement.” I strongly encourage you to read the university's complete policy on academic honesty, which is provided on the web at: http://www.csus.edu/admbus/umanual/UMA00150.htm.

As an example of plagiarism, if you cut and paste material from someone else's work and do not acknowledge the source of that material, that's considered plagiarism. If, after reviewing the university's policy, you are still unsure about what is and what is not plagiarism, please ask! Anyone caught cheating or plagiarizing will not receive the points for the particular assignment on which they cheated or plagiarized; in other words, you will receive an F on the assignment. In addition, I may forward their name to the dean of student affairs. If a student is caught plagiarizing a second time, they will receive an F grade in the course and their name will be forwarded to the dean of student affairs.

Persons with disabilities
I am sensitive to students with disabilities. Any student having a visible or invisible disability that adversely affects their ability to succeed in my class should speak with me by the second week of class. This will allow me enough time to make reasonable accommodations in advance of exams and quizzes.

A note on cell phones
A cell phone that rings during class is disruptive to me and to other students. If, for personal reasons, you must leave your cell phone on and take a call during class please set the ringer to
vibrate and take the call outside of class. I request that all cell phones be turned off during class.

Final Project Dr. Kneitel
Bio 167 Biometrics Fall 2005

The purpose of the final project is to give you the experience of taking a data set (that you have collected or obtained) and go through the process of summarizing, analyzing, and presenting data in the context of a research project. Consequently, the methods and results sections will be worth more points relative to the introduction and discussion. However, as we’ve seen this semester, statistics do not occur in a vacuum. They are tools used to summarize, present, and test hypotheses— all part of a biological investigation. This will be graded on content (40%), analyses/tables/figures (30%), structure and logic flow (15%), and writing quality (15%).

Use the data set to test a hypothesis (-es) using the tools we have learned this semester and write it up in a journal article format. To standardize, we will use format found in the journal *Ecology*. Use the *Writing Papers in the Biological Sciences* by McMillan (especially Chapter 4) or the handout that I can provide upon request as a guide to what belongs in each section. The paper should include the following sections:

1. Title
2. Abstract
3. Introduction
4. Methods
5. Results
6. Discussion
7. Literature cited

This paper requires at least 10 references from journal articles or books, **NO textbooks, websites, or encyclopedias.** JSTOR is a great resource for getting references. There is no minimum, but I do expect substance and will cap the paper at 10 pages. Remember to address issues related to the tests’ assumptions— do your data meet them? Are you conducting the correct test? Was the data collected properly? Did this affect your results? How could it be collected properly? Keep these issues in mind.

Finally, **PROOFREAD, PROOFREAD, PROOFREAD!**

The final paper is due on December 1 and rough drafts can be submitted to me by November 15 for comments. On December 7, each student will make an oral presentation in lab summarizing their article. Oral presentations should be approximately 8 minutes each with 2 minutes available for questions.
JOURNAL ARTICLE EVALUATION OUTLINE

TITLE:

AUTHOR(S):

JOURNAL:

DATE:

VOLUME:

PAGES:

A. INTRODUCTION

1. DOES THE TITLE OF THE RESEARCH ARTICLE GIVE ANY INDICATION OF THE TYPE OF STUDY BEING REPORTED: IE., DESCRIPTIVE, CORRELATIONAL, OR CAUSAL - COMPARATIVE.

2. WERE THE INDEPENDENT AND DEPENDENT VARIABLES MENTIONED IN THE TITLE?

3. IN WHAT PART OF THE ARTICLE DID YOU FIND WHAT KIND OF STATISTICAL TOOLS WERE BEING USED?

B. ANALYZING THE VARIABLES.

1. WHAT IS (ARE) THE INDEPENDENT VARIABLES(S). BE SPECIFIC!
   A. WHAT IS (ARE) THE NATURE OF THE MEASUREMENTS: IE., NOMINAL, ORDINAL, RATIO, INTERVAL, AS WELL AS WHETHER OR NOT THEY ARE CONTINUOUS OR DISCRETE.

2. WHAT IS (ARE) THE DEPENDENT VARIABLES(S). BE SPECIFIC!
   A. WHAT IS (ARE) THE NATURE OF THE MEASUREMENTS: IE., NOMINAL, ORDINAL, RATIO, INTERVAL, AS WELL AS WHETHER OR NOT THEY ARE CONTINUOUS OR DISCRETE.

C. HYPOTHESES.

1. WERE THE HYPOTHESES CLEAR AND UNDERSTANDABLE?

2. WHAT WAS THE HYPOTHESIS (OR HYPOTHESES)? WHAT WAS THE NULL HYPOTHESIS (ES)? WAS IT APPROPRIATE FOR THE STUDY?

3. DID THE INTRODUCTION ADEQUATELY SET UP THE HYPOTHESES?

3. IF THE AUTHORS DID NOT PROVIDE HYPOTHESES, TRY TO "CREATIVELY" GENERATE WHAT YOU THINK THEY SHOULD HAVE BEEN.
4. ATTEMPT TO STATE THE NULL HYPOTHESIS FOR EACH ALTERNATIVE HYPOTHESIS.

5. DID THE AUTHORS SPECIFY A SPECIFIC **ALPHA RISK LEVEL** FOR REJECTING THE NULL HYPOTHESIS? IF SO, WHAT WAS IT? IF THEY DID NOT SPECIFY THE **ALPHA RISK LEVEL**, WHAT DO YOU THINK IT MUST HAVE BEEN?

D. SAMPLE.

1. DO YOU BELIEVE THAT THE SAMPLE WAS LARGE ENOUGH?
   A. GIVEN THE SAMPLE SIZE COULD YOU COMPUTE THE **STANDARD ERROR OF THE MEAN**. TO ACCOMPLISH THIS YOU WOULD NEED THE VALUES FOR BOTH N AND THE **STANDARD DEVIATION**. DID THEY PROVIDE YOU WITH THIS DATA. WHAT DO YOU BELIEVE THE "CRITICAL REGION" FOR REJECTION OF THE NULL HYPOTHESIS SHOULD HAVE BEEN.

E. RESULTS AND CONCLUSIONS.

1. ARE APPROPRIATE STATISTICAL TOOLS USED?
   A. EG., WAS THE "HOMOGENEITY OF VARIANCE" ASSUMPTION TESTED (AN F-MAX TEST). COULD YOU DO ONE?
   B. EG., THE NATURE OF MEASUREMENT FOR THE INDEPENDENT AND DEPENDENT VARIABLES AND HOW MANY OF THEM MIGHT INDICATE THE TYPE OF STATISTICAL TOOL THAT SHOULD HAVE BEEN USED?

3. WERE GRAPHIC CHARTS USED?
   A. IF SO, WERE THEY HELPFUL IN SHOWING THE RESULTS.
   B. IF GRAPHIC CHARTS WERE NOT USED, TRY TO CONSTRUCT THEM FROM THE REPORTED DATA: IE., SKETCH OUT A BAR GRAPH, HISTOGRAM, OR FREQUENCY POLYGON.

4. DOES THE INVESTIGATOR RELATE THE RESULTS TO THE HYPOTHESES?

5. DOES THE INVESTIGATOR OVER-CONCLUDE, THAT IS, ARE THE CONCLUSIONS SUPPORTED BY THE DATA.