Quantitative Methods for Biologists
Course Syllabus
Fall 2014

Instructor: Dr. Rachel Cartwright

Lecture times: Section 1 – Mon / Wed 3 - 4.15 pm
Section 3 – Tues / Thurs 3 - 4.15 pm

Classroom: Aliso Hall 134

Office: Manzanita 1116

Office hours: Wednesdays 1.30-2.45 pm, other times by arrangement.

Contact: Via email at rachel.cartwright@csuci.edu

Required texts:
Statistical methods in practice: Lecture Notes - by R. Cartwright.
Available for purchase from Jessica Dalton, Biology program administrator, Aliso 103, between 9 and 6 pm daily.

Cost $15.00 for both booklets. Please note both items are required

Course Overview:

This course introduces students in the biological sciences to the quantitative skills and technological tools necessary to evaluate scientific literature and carry out original research in this discipline. Topics include the principles of biological sampling design, hypothesis generation for biological experiments, collection of observational and experimental data, statistical analysis and interpretation of biological data, and the presentation of results.

Practical, problem solving sessions will provide hands on experience and ensure that students are able to understand, apply and interpret results obtained from the range of statistical software applications which are now widely used in the biological sciences.

Student learning Objectives:

On completion of this course students will be able to:

- choose an appropriate sampling scheme and/or experimental design for a given biological question
- select and apply the appropriate analytical methods to biological data
- demonstrate the necessary computer skills for biological data management, analysis and graphical presentation of key findings
- evaluate critically the primary literature in observational and experimental biology
**Course Structure:**

This course will be a hybrid course, comprising online lectures that students will review during their own personal study time and class sessions, which will be devoted to hands-on activities, problem solving exercises and the development of proficient skills in data analysis.

Review of the assigned lectures prior to the class will be an essential and required component of the course. The video lectures have been prepared specifically for this course and will be accessible via links to YouTube. This online format will allow students to work at their own speed through the lecture material. After viewing the lectures, students will be directed to an online quiz that will test their comprehension of the concepts covered in each lecture.

During class sessions, students will work on a range of exercises and activities designed to reinforce their understanding of the course material and build their skills in data analysis. These class sessions will provide students with the opportunity to seek assistance as required during completion of the practical exercises. Attendance at all class sessions is expected and mandatory unless otherwise indicated by the class instructor.

**Assessment:**

Assessment will include four assessment tests, a selection of practical exercises, assignments, group and individual projects. Full details of these will be presented during the course.

The final project will require students to assemble, organize and analyze data independently, applying the range of skills that they have acquired through the course. Submission of this project is due on the scheduled final exam date and time, all data sets for use in the project must be submitted for approval, prior to the last class.

Points will be allocated as follows:

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>400</td>
<td>Assessment tests (4 @100 each)</td>
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<tr>
<td>150</td>
<td>Assignments</td>
</tr>
<tr>
<td>100</td>
<td>Completion of the workbook</td>
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<tr>
<td>100</td>
<td>Pop quizzes</td>
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<tr>
<td>50</td>
<td>Group project</td>
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<td>200</td>
<td>Final project</td>
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Total points: 1000

**Grading System:**

The final grade will be calculated based on the breakdown of tests and assessments as described. The absolute grade will be the grade assigned, no curve based grading.

Grades are as follows: -

- **A** = 900 and above
- **B** = 800 – 899
- **C** = 700 - 799
- **D** = 600 - 699
- **F** = below 600.

Extra credit options may be offered throughout the semester, at the instructor’s discretion.
Missed Tests:

Make-up of missed tests is very challenging, as students require computer access to complete the tests. Please make every effort to be present for the scheduled tests. Make-up of tests will be on a case specific basis and only at the instructor’s discretion.

Dates will be set based on the progress of the class. Where scheduling conflicts arise students will be encouraged to attend the alternate class to cover any material they may miss, or tests that they cannot take on schedule. You should make every effort to attend every class. You will find that any missed classes will impact your progress and your grade on the course, but most importantly, absences impact your comprehension and understanding of the course content.

Extra help:

For many students, their first experience in quantitative data analysis can be quite challenging. In my experience as an instructor, I find that students progress through this course at very different rates and a little extra help along the way can often have remarkable results. Some students can find get benefit in working through problems within a study group setting. For other students, one to one help is a better model. Typically, addressing any areas of concern as they arise during the course will instill and maintain confidence and set students on a path to success. Sources of assistance include:

**Individual or small group consultations during office hours** I would like to actively encourage you to come to my office during my office hours. You may come individually, or in small groups. Bring details of key questions for review, either from the online lectures or in connection to the exercises we will be working on during class sessions.

**Biology tutor support**. Student tutors are available for this class. These students have previously taken the class and can provide help with review of material, course content and test preparation. Their schedules will be on display in the study area on the second floor in Aliso Hall.

**Peer-Led Team Learning** This program consists of learning communities designed for students who want to excel in class while simultaneously developing study and learning skills that will be of use in all science and mathematics classes. A weekly 2-hour commitment is required. For more information, visit [www.csuci.edu/projectacceso/student-support-services.htm](http://www.csuci.edu/projectacceso/student-support-services.htm).

Instructor’s advice:

Attendance at every lecture is mandatory and expected. It is also the single best method of ensuring a good grade in this class. You will need to make every attempt to ensure that you do not miss classes, as this will impede your progress. If you have extenuating circumstances that cause you to miss class, please inform me so that we can make arrangements for you to catch up.

Some assignments will require that you work on your own, out of class. This is an essential component of the course and you will need to have access to the SPSS program that we will be using, to complete this work. SPSS is available throughout the campus, on library computer terminals, in the tech center study room, at the Hub and on the dormitory computers. You will need to decide where and when you will access the program, to complete your assignments.

Deadlines for coursework must be adhered to. Time management is a key skill that students must master over the course of their studies. Late submissions will only be accepted in extremely extenuating circumstances, so please keep up with the course work as it is set in class. The final
project due date is set as the date of the final exam for the course. Extensions to this date would only be granted to extreme and unusual circumstances. Please keep this in mind and manage your time carefully at the end of the semester.

Please make every effort to be punctual to class, out of courtesy to your fellow students, so that classes can begin and finish on schedule, and don’t forget to turn off mobile phones during class.

You will be working independently on computer terminals during these classes. However please resist the temptation to be distracted. If you wish to check your email, do so before the class starts. Surfing the internet during class times is prohibited and students in the class will be expected to adhere to this rule. Face book, your email page and instant messaging are all prohibited activities / websites during class sessions.

Please note that while you will be encouraged to work together in class, plagiarism, in any form, at any point in the course, will result in the assignment of a failing grade.

Finally, I sincerely hope that you find this course useful and interesting. Please don’t hesitate to ask for extra help as and when you need it. I am happy to provide extra help out of class, either during scheduled office hours, or at other times by arrangement.

This is a tentative schedule and may be changed at the instructors’ discretion. Students with any degree of disability should inform the instructor and every effort will be made to fully accommodate the student. The instructor maintains the right to drop students however students themselves are responsible for withdrawing from this class in a timely manner. Plus or minus grades will only be awarded at the discretion of the instructor, in exceptional circumstances. All students are expected to adhere to university standards of behavior, attitude and academic honesty.
Course outline:

The course will be organized into four key modules. For each module, there will be a series of lectures in which the key course content will be presented. During the lectures, you will have worksheet to complete that highlights and emphasizes the key points of the lecture.

On completion of each lecture, you will then be working through a series of data analyses, that will allow you to practice and exercise your new skills. On completion of each module, we will meet for a review class, prior to the module test, which will be scheduled for the next class meeting.

Module 1: Describing data

- Statistics and Sampling techniques
- Classifying and Displaying data
- Techniques for Exploratory Data Analysis
- Probabilities and the basics of hypothesis testing

Review – Conducting an exploratory data analysis
Assessment Test 1

Module 2: Comparing categories

- Describing the distribution of data I – Binomial and Poisson distributions
- Testing proportions within categorical data; the Binomial and Chi-Squared goodness of fit tests
- Contingency tables and associations within categorical data sets

Review – Analysis of categorical data
Assessment Test 2

Module 3: Defining groups

- Describing the distribution of data II – The normal distribution
- Defining two groups within numerical data – The two sample t and paired samples tests
- Working with more than two groups using ANOVA
- Dealing with non-normal data: Non parametric tests and data transformations

Review – Defining groups with numerical data
Assessment Test 3

Module 4: Detecting trends

- Detecting correlation between numerical variables
- Introduction to regression and methods to determine the strength of relationships
- Multivariate methods and model-building.

Review – Detecting trends within data sets; correlation and regression.
Assessment Test 4

During the class, we will be using statistical software, such as Excel and SPSS, both in data analysis and display. While the dedicated statistical package (SPSS) has a steep learning curve, once students master this software, they will be able to apply their skills in statistical analysis to their work in other courses as they advance within the university.

As part of the class we will be using a wide variety of (mostly biological) data sets taken from the scientific literature. These provide examples of good – and bad methods – of data analysis. On completion of the course, as students take on their final projects, this provides the opportunity to ask and answer their own questions, using your full complement of newly acquired skills in data analysis.