Statistical Methods for Research I, MATH 6315
Department of Mathematics and Statistics
Fall 2016

A. COURSE INFORMATION

Course number/section: MATH 6315.001, .201, .G01, .G21
Class meeting time: Section .201 MW 9:00-9:50 AM, Section .G21 MW 11:00-11:50 AM, other sections use pre-recorded material
Class location: Section.201 in CI 222, all other sections online
Course Website: bb9.tamucc.edu

B. INSTRUCTOR INFORMATION

Instructor: Dr. Blair Sterba-Boatwright
Office location: CI 312
Office hours: MW 3:30-5:30 pm; T 1-3 pm; other times by appointment.
Telephone: 361-825-2724
e-mail: blair.sterbaboatwright@tamucc.edu
Skype: ber26nard
Appointments: Contact me by e-mail to set up an appointment

C. COURSE DESCRIPTION

Course Description
This course is undergraduate students in non-MATH disciplines and is designed to prepare them to use statistical methods in their future graduate research. This is a non-calculus exposition of the concepts, methods and usage of statistical data collection and analysis. Topics include descriptive statistics, the t-test, the one and two-way analysis of variance, multiple comparison tests, and multiple regression. Students also learn how to conduct these analyses using computer software and how to properly report their findings.
D. PREREQUISITES FOR THE COURSE

Prerequisites
MATH 1442, MATH 3342, or the equivalent.

Corequisites
None

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)
None

Optional Textbook(s) or Other References
Some students feel that my lecture notes are complete enough to suffice as a reference for this course. However, I don’t feel they would constitute an adequate reference for your entire professional career. Therefore, depending on your budget, I recommend that you get some of the following books, if not for this semester, then for the future:

- Gotelli, N. J. and Ellison, A. M. (2012) A Primer of Ecological Statistics, 2nd ed., Sinauer Associates, ISBN-13: 978-1605350646. This is the book on which my lecture notes are based. This is an excellent introduction to statistics, particularly (as the title indicates) for ecologists, but does not cover as much material as Quinn and Keough. It includes several useful chapters that I won’t discuss much or at all, including a couple on designing field experiments.

- Quinn, G. P. and Keough, M. J. (2002) Experimental Design and Data Analysis for Biologists. Cambridge University Press. ISBN 978-0-521-00976-8. This is a more extensive coverage of statistics than Gotelli and Ellison, and is the text we use for Stats II, if you’re heading for that course. It is also probably the best reference book of the three I’ll mention. However, I don’t think it’s as good a text for a first semester course as Gotelli and Ellison, primarily because it moves a little fast for beginners and because the early chapters are not organized the way I’d do it. Also, I think a few of their recommendations are becoming dated as new statistical techniques have become more mainstream since the book was written.

- Dalgaard, P. (2008) Introductory Statistics with R, 2nd edition. Springer-Verlag. As you can tell by the title, this book covers both how to use R and statistics, but the first two chapters are purely about R. Unlike the other two books, it’s not aimed primarily at biologists. I will not be using this book in the course, but it’s a good reference for aspects of R.

Supplies
You will need a copy of the software package R on your home and/or office computers. R is free software and may be downloaded from [http://cran.r-project.org](http://cran.r-project.org). I also strongly recommend RStudio, also free, available from [http://www.rstudio.com/](http://www.rstudio.com/) as a useful front end for R. Also, labs will be broadcast online using Webex. Students who
intend to attend labs online will need to download a Webex plug-in for their browser. I will be sending a permanent link to the relevant URL near the start of classes, and you will be prompted to download the necessary plug-in for your browser from that link.

**F. STUDENT LEARNING OUTCOMES AND ASSESSMENT**

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:

1. analyze experimental situations to determine which discrete or continuous distribution is applicable and, in cases requiring the normal distribution, choose among several elementary transformations to increase normality where it is not naturally present in the data
2. use graphs and summary calculations to explore datasets and anticipate results or difficulties in the subsequent analysis
3. compute confidence intervals using both classical methods based on the Central Limit Theorem and using bootstrapping techniques, and explain which technique is most appropriate for a given dataset
4. analyze descriptions of experiments to determine appropriate statistical experimental design, and use both frequentist techniques and Monte Carlo methods to test hypotheses for that design
5. create simple and multiple regression models, interpret the results of these models, and diagnose and correct problems with the models
6. create one-way and two-way ANOVA models, interpret the results of these models, perform appropriate *post-hoc* testing with these models, and diagnose problems with the models.

**G. INSTRUCTIONAL METHODS AND ACTIVITIES**

Lectures in this course are pre-recorded and available via the course BlackBoard page. Labs will be conducted using RStudio with scripts distributed before class to demonstrate how to analyze data. Unless I forget, all online labs will be recorded and links to the recorded versions posted on the course BlackBoard page for your convenience. **Because this course relies heavily on online recordings, it is vital that you inform me of any issue regarding your ability to access and use them as soon as possible, so that we can address such issues.**
H. MAJOR COURSE REQUIREMENTS AND GRADING

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>25%</td>
</tr>
<tr>
<td>Tests (3)</td>
<td>25% each</td>
</tr>
</tbody>
</table>

Further information:

- Homework will involve computer-based analysis of ecological and biological datasets, plus appropriate writeups. Students submit HW electronically through BlackBoard, and are permitted to re-submit homework multiple times until the assignment is closed (see “Late Work” policy below).

- Tests are open book, notes, computer, Internet: any resource is permitted except help from another person. Tests may be taken either in an electronic format or on paper, but in either case will require the use of R during the test. Examples of tests from previous semesters will be available on the course BlackBoard page. There is no separate “Lab Exam”.

- Test 1 will be Monday, Oct. 3, from 8-10 AM for Corpus Christi students and 10-12 AM for Galveston students. Test 2 will be Wednesday, Nov. 2, at the same times. For the Corpus Christi students, Test 3 will be in the standard exam slot for the lab section, which is Monday, Dec. 12, from 8:00-10:30 AM. For Galveston students, Test 3 will be in the more-or-less standard exam slot for the course, which is Tuesday, Dec. 13, 8:00-10:30 AM.

Based on the above, grades will be assigned according to the following scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90-100</td>
</tr>
<tr>
<td>B</td>
<td>80-89</td>
</tr>
<tr>
<td>C</td>
<td>70-79</td>
</tr>
<tr>
<td>D</td>
<td>60-69</td>
</tr>
<tr>
<td>F</td>
<td>0-59</td>
</tr>
</tbody>
</table>

I. COURSE CONTENT/SCHEDULE

Chapter references below are to the Gotelli and Ellison text.
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture topic</th>
<th>Lab topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Course introduction; probability (Chapter 1)</td>
<td>Intro to R</td>
</tr>
<tr>
<td>2</td>
<td>Probability (Chapters 1 and 2)</td>
<td>Handling data in R; basic graphs in R</td>
</tr>
<tr>
<td>3</td>
<td>Probability (Chapter 2)</td>
<td>R as probability calculator</td>
</tr>
<tr>
<td>4</td>
<td>Confidence intervals (Chapter 3)</td>
<td>Confidence intervals in R, including diagnostics</td>
</tr>
<tr>
<td>5</td>
<td>Hypothesis testing (Chapter 4)</td>
<td>Confidence intervals in R using bootstrap</td>
</tr>
<tr>
<td>6</td>
<td>Hypothesis testing (Chapter 4)</td>
<td>Test 1 (target date: Wednesday, Sept. 30); paired t-tests in R</td>
</tr>
<tr>
<td>7</td>
<td>Hypothesis testing (Chapter 5)</td>
<td>Two-sample t-tests in R; statistical power</td>
</tr>
<tr>
<td>8</td>
<td>Hypothesis testing (Chapter 5)</td>
<td>Alternatives to two-sample t-tests: Monte Carlo and non-parametric methods</td>
</tr>
<tr>
<td>9</td>
<td>Data archiving; transformations and related issues (Chapters 6 and 8)</td>
<td>Monte Carlo and non-parametric methods (cont.)</td>
</tr>
<tr>
<td>10</td>
<td>Simple regression (Chapter 9)</td>
<td>Simple regression and diagnostics in R</td>
</tr>
<tr>
<td>11</td>
<td>Multiple regression (Chapter 9)</td>
<td>Test 2 (target date: Wednesday, Nov. 4); simple regression (cont.)</td>
</tr>
<tr>
<td>12</td>
<td>Multiple regression (Chapter 9)</td>
<td>Multiple regression</td>
</tr>
<tr>
<td>13</td>
<td>ANOVA (Chapter 10)</td>
<td>One-way ANOVA , diagnostics, post-hoc testing</td>
</tr>
<tr>
<td>14</td>
<td>ANOVA (Chapter 10)</td>
<td>Post-hoc testing (cont.), two-way ANOVA</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Test 3 (date differs by campus)</td>
</tr>
</tbody>
</table>

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

J. COURSE POLICIES

Attendance
Corpus Christi students may attend lab live during the scheduled MW 9 AM classes, or online along with Galveston/College Station students at MW 11 AM, as they wish, without prior notice to me. All students may rely on recorded versions rather than attending live, at their discretion, without prior notice to me.

Late Work, Multiple Submissions, and Individual Work on Homework
On homework assignments, I will announce an official due date and time. However, students may continue to submit without penalty past that deadline until the answer key to that assignment is posted on BlackBoard. Once an answer key has appeared on the Blackboard site, no further submissions are permitted. I reserve the right to
announce “hard” deadlines that do not include this automatic extension (usually the last assignments before a test).

If you have submitted an assignment, but would like to correct or improve your work, you may resubmit the assignment as many times as you wish until either your work is graded or the assignment is closed for the class by the posting of the answer key. In my grading, I will ignore all submissions except the most recent one.

I do not mind if you work on Homework with fellow students. However, I expect you to submit individualized scripts, not just copies of a single document. Students who submit substantially identical work will receive a 0 on the assignment.

Incompletes
A grade of I (Incomplete) will only be given in exceptional circumstances, such as a death in the family or personal injury that might prevent someone from taking the final test. In this case, it is the responsibility of the student to notify me as soon as possible, preferably by e-mail, and to complete the required “Incomplete Form” available from the University Registrar. If this is not done, a score of 0% will be assigned for any incomplete tests and a final grade will be computed using the criteria described above.

K. COLLEGE AND UNIVERSITY POLICIES

Academic Integrity (University)
University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as ones own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

Classroom/Professional Behavior
Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructors ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

Statement of Civility
Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in
a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

Deadline for Dropping a Course with a Grade of W (University)
The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must be submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar [http://www.tamucc.edu/academics/calendar/] for the last day to drop a course.

Grade Appeals Appeals (College of Science and Engineering)
As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at [http://www.tamucc.edu/provost/university_rules/index.html] and the College of Science and Engineering Grade Appeals webpage at [http://sci.tamucc.edu/students/GradeAppeal.html]. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

Disability Services
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

[http://disabilityservices.tamucc.edu/]

Statement of Academic Continuity
In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University-Corpus Christi; this course would
continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. OTHER INFORMATION

Academic Advising
The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The Colleges Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.