Mixed Effects Models for Scientists, MATH 6317
Department of Mathematics and Statistics
Fall 2016

A. COURSE INFORMATION

Course number/section: MATH 6317.001 and .G01
Class meeting time: MW 2:00-3:15 pm
Class location: OCNR 255, simultaneously online via Webex
Course Website: bb9.tamucc.edu

B. INSTRUCTOR INFORMATION

Instructor: Dr. Blair Sterba-Boatwright
Office location: CI 312 and NRC 3208 1/2
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

Catalog Course Description
This course will deal with extensions to the regression and ANOVA that are frequently useful in dealing with ecological data. Topics include: using bootstrapping for significance testing; generalized additive models; using generalized least squares to deal with non-homogeneous data; working with fixed and random factors; handling temporally correlated and spatially correlated data; and the generalized linear model (Poisson, logistic, and negative binomial regression).

How this course fits into our graduate statistical offerings
In some sense, this is a companion course to MATH 6316, Statistical Methods in Research II, in that this course offers "fixes" for many of the issues that arise in 6316 that we don’t have time to deal with there. There is some advantage to having had 6316 prior to this course, but I do not assume any knowledge of 6316 material while teaching this course. In addition, this course covers topics that go well beyond anything in 6316.

D. PREREQUISITES FOR THE COURSE

Prerequisites
Prerequisite: MATH 6315 or MATH 6316; in particular, a good basic understanding of linear regression and at least exposure to multiple regression.

Corequisites
None
E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)

Software
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. Determine appropriate statistical analyses based on experimental designs and/or features of datasets
2. Use R to perform all necessary calculations and make all necessary graphics, including minimal programming expectations for the bootstrap
3. Interpret the results of the statistical analyses in an ecological context
4. State limitations and weaknesses of the results of statistical analyses

G. INSTRUCTIONAL METHODS AND ACTIVITIES

Although it’s not formalized in the course schedule as it was with MATH 6315 and MATH 6316, I am using the same lecture-lab format.

- **Lecture:** All lectures will be pre-recorded and posted on the course Blackboard site for you to download and watch. I will post lecture notes on the course Blackboard page as I get them complete. 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.
• **Lab:** Labs will be presented face-to-face on the Corpus Christi campus and simultaneously streamed “live” over the internet using Webex videoconferencing software. Labs will use R “scripts” that will also be posted on the Blackboard page or e-mailed to you, depending on how far I get behind.

**H. MAJOR COURSE REQUIREMENTS AND GRADING**

All four learning outcomes will be measured using two types of assessment, homework and a project.

- **Homework:** There will be homework assignments for each chapter, typically involving the use of R to analyze one or more datasets using the methods of that chapter. Homework analyses will be similar to examples from lab. Students may resubmit homework assignments as many times as they wish until a grade is assigned.

- **Project:** There will be a project due at the end of the semester. This will be similar to the homework, but will involve substantially more analysis and writing than the homework. Students will be expected to use a formal Intro/Methods/Results/Discussion format in their writeup, and will present their project to the class. Based on enrollments at the time of writing, there should be time for all presentations to be done during the standard final exam slot for each campus (Corpus Christi: Monday, Dec. 12, 1:45-4:15 pm; Galveston: Tuesday, Dec. 13, 3:30-5:30). I will provide more information about the project during the semester.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>60%</td>
</tr>
<tr>
<td>Project</td>
<td>40%</td>
</tr>
</tbody>
</table>

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**

I have never managed to stay on one of these schedules for more than a couple of weeks, so you should regard the following as advisory rather than a promise.

NB: The dates below follow the Corpus Christi semester calendar. The Galveston calendar is slightly different; I will arrange a work-around for Galveston students before the start of the Fall semester.
### Dates and Topics

<table>
<thead>
<tr>
<th>Dates</th>
<th>Topic</th>
<th>Chapter</th>
<th>HW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 24, 29, 31</td>
<td>Maximum likelihood and AIC, review of linear models</td>
<td></td>
<td>HW 1</td>
</tr>
<tr>
<td>Sept. 7, 12</td>
<td>Generalized additive models</td>
<td>3</td>
<td>HW 2</td>
</tr>
<tr>
<td>Sept. 14, 19, 21</td>
<td>Generalized least squares</td>
<td>4</td>
<td>HW 3</td>
</tr>
<tr>
<td>Sept. 26, 28, Oct. 3</td>
<td>Random factors</td>
<td>5</td>
<td>HW 4</td>
</tr>
<tr>
<td>Oct. 5, 10, 12</td>
<td>Models with temporal autocorrelation</td>
<td>6</td>
<td>HW 5</td>
</tr>
<tr>
<td>Oct. 17, 19</td>
<td>Models with spatial autocorrelation</td>
<td>7</td>
<td>HW 6</td>
</tr>
<tr>
<td>Oct. 24</td>
<td>Discrete probability models</td>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>Oct. 26, 31, Nov. 2</td>
<td>Poisson and negative binomial regression</td>
<td>9</td>
<td>HW 7</td>
</tr>
<tr>
<td>Nov. 7, 9</td>
<td>Logistic regression</td>
<td>10</td>
<td>HW 7</td>
</tr>
<tr>
<td>Nov. 14, 16</td>
<td>Zero-inflated and zero-adjusted models</td>
<td>11</td>
<td>HW 8 (?)</td>
</tr>
<tr>
<td>Nov. 21</td>
<td>Generalized Estimating Equations</td>
<td>12</td>
<td>None</td>
</tr>
<tr>
<td>Nov. 23</td>
<td>Reading day, no classes (Why? Today’s kids are wimps!)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov. 28, 30, Dec. 5</td>
<td>GLMM’s and GAMM’s</td>
<td>13</td>
<td>None</td>
</tr>
<tr>
<td>Dec. 12/13</td>
<td>Project presentations</td>
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</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/Tardiness**
  Because all classes are broadcast online, Corpus Christi students may choose to attend online without prior notice to me. Because all classes are recorded, students may rely on the recordings instead of attending class, also without prior notice to me.

- **Multiple Submissions, Deadlines, and Individual Work on Homework**
  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 the assignment is closed (see next paragraph). I will ignore all submissions except the most recent one when I grade.

  I tend to be flexible (some students would say, “annoyingly vague”) about deadlines for HW assignments. When I post an assignment, I will recommend that you complete and submit it by a given date. However, you may submit/re-submit an assignment until one of the following two things happens:

  - I post the answer key on Blackboard
  - I grade a previous submission of yours for that assignment

  I will provide at least 24 hours notice before either of the above events.
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.

- **Extra Credit**
  There will be an occasional extra credit problem on homework. These are designed primarily to challenge students to go beyond the regular course material, and/or are too gigantic to require students to do. Rewards for extra credit problems are small—it’s mostly about the challenge!

- **Cell Phone Use**
  I tend to be forgetful about muting my cell phone before class, so I won’t penalize you if yours goes off during class. However, let’s all try to be mindful of this.

### 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 one's 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/](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](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](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/](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 UniversityCorpus 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 oper-
national 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.