Statistical Computing

Text:  

Course Web Site:  
http://math.arizona.edu/~piegorsch/675/STAT675.Spring20.html

Instructor:  
Professor Walter W. Piegorsch, office: 230 BSRL (check in at Keating Bldg. Room 102); phone: 621-2357.

Office Hours:  
Tu 12:30 – 1:45 pm  
Th 12:30 – 1:45 pm  
or by appointment.

Attendance:  
Students are expected to attend class. If important circumstances prevent this, it is the student’s responsibility to find out what was covered in class, what was assigned for reading or homework, and what special announcements (if any) were made. “Excessive absence” in this class will be construed to be absence from more than 10 percent of the scheduled class sessions, whether excused or unexcused, and will be subject to Administrative Drop as per University policies.

Grading:  
Exam 1  
Tuesday, Mar. 3  
100 points  
Exam 2  
Tuesday, April 14  
100 points  
Final Exam (Comprehensive)  
Tuesday, May 12 (10:30 am – 12:30 pm)  
100 points  
Total  
300 points  
A = 270–300  
B = 240–269  
C = 210–239  
D = 195–209  
E = 0–194

Homework:  
Required. Due as assigned. No exceptions. Graded ✔ or ✗.

Make-Up Exams:  
Considered only for Exams 1 and 2: given only in dire circumstances, only if identified in advance, and only during the week following the scheduled exam.

The regulations in the Student Code of Conduct and Code of Academic Integrity prohibit all forms of student academic dishonesty, including but not limited to cheating, fabrication, and plagiarism. Violations can result in serious penalties, including expulsion from the University. Students should turn off all electronic devices during class unless prior arrangements are made with the instructor. This includes, but is not limited to cell phones, recording devices, mp3 players, PDAs, and computers. Information on these Codes is available at http://deanofstudents.arizona.edu/codeofacademicintegrity and http://deanofstudents.arizona.edu/student-code-conduct-student-faqs. It is assumed that all students are familiar with and will abide by these Codes.

Note: the Student Code of Conduct (5-308.F.11) dictates that no person or organization may interfere with University-sponsored classroom activities. This policy will be enforced as necessary.

GENERAL ADVICE:  
• Read the sections of the text to be covered prior to the class session.  
• Attend class regularly. Arrive on time.  
• Ask questions if you don’t understand an issue. (See me after class if time is short.)  
• Attempt to do all assigned homework. (Come to Office Hours if encountering difficulty.)
Course Syllabus for STAT 675
January 2020

Description: Statistical Computing (3 units) – Techniques of advanced computational statistics. Numerical optimization and integration pertinent for statistical calculations; simulation and Monte Carlo methods including Markov chain Monte Carlo (McMC); bootstrapping; smoothing/density estimation; and other modern topics.

Prerequisite(s): STAT 566/MATH 566, or equivalent, and knowledge of a computer programming language such as R, FORTRAN, C/C++, or Python.

Purpose of Course: To acquaint advanced graduate students in statistics, biostatistics, mathematics, and related fields with the modern methodologies and issues associated with computational statistics. The course strikes a balance between theoretical foundations and computational implementation.


Topics: 

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<tr>
<th>Topic</th>
<th>Book Sections</th>
<th>Time</th>
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<tbody>
<tr>
<td>Pseudo‐Random Numbers</td>
<td>1, 3</td>
<td>3.5 weeks</td>
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<tr>
<td>Review of R;</td>
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<td>Random number generation: Inverse-transform; acceptance-rejection; transformations; multivariate probability calculations</td>
<td>3.5 weeks</td>
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<td>Monte Carlo Integration</td>
<td>5.1–5.7</td>
<td>2.5 weeks</td>
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<td>Simulation and Monte Carlo integration; variance reduction; antithetic variables/control variates; importance sampling; stratified sampling</td>
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<td>Resampling Methods</td>
<td>7.1–7.2, 7.4–7.6</td>
<td>2 weeks</td>
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<tr>
<td>Bootstrapping; jackknife resampling; percentile confidence intervals</td>
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<tr>
<td>Markov chain Monte Carlo (McMC)</td>
<td>2.8, 9.1–9.4</td>
<td>2.5 weeks</td>
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<td>Markov chains; Metropolis-Hastings algorithm; Gibbs sampling; convergence</td>
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<td>Density Estimation</td>
<td>10.1–10.3</td>
<td>1.5 weeks</td>
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<td>Univariate density estimation; kernel smoothing multivariate density estimation</td>
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<td>Numerical Methods</td>
<td>11.1–11.8</td>
<td>2.5 weeks</td>
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<td>Root finding; more on numerical integration; numerical maximization/minimization; constrained and unconstrained optimization; EM (Expectation-Maximization) algorithm; simplex algorithm</td>
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14+ weeks