MATH 6376
STATISTICAL COMPUTING

Spring 2010
TR 4:00-5:15, CU 641
3 Credit Hours
Office Hrs: TR 2:00 - 4:00, by appointment

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Course catalogue: “Computationally-intensive methods in statistics, including random number generation and Monte Carlo methods, data partitioning and re-sampling, numerical and graphical methods, nonparametric function estimation, statistical models and data mining methodology, analysis of large data sets.”

Course Objectives: This course will provide students with the basic building blocks in statistical computing, as well as a survey of more advanced methods at the frontier of the discipline. Students will learn how to:

• Employ the computer in advanced theoretical and applied statistical research.
• Generation of random numbers
• Use of Monte Carlo simulation to test hypotheses, estimate variability, and examine the properties of statistical methods.
• Exposure to peer-reviewed statistics research

Prerequisites: MATH 4820/5820 or 4830/5830 and 4387/5387

Readings
Required Text:


Recommended Text:


We will also incorporate peer-reviewed journal articles from the statistics literature. Please see the course schedule for the references.

Software: We will use R, which is a free, internet downloadable, statistical software. The MERC computer lab has R installed on the computers. You can download R from the following website: http://cran.r-project.org/. Simply choose the Windows (or Linux or Mac) links and download the base binaries. Please check out the video tutorials for guidance on basics, importing data, simple analyses, plotting, and installing packages:

http://math.ucdenver.edu/RTutorial/.

Some useful text resources for R syntax and code follow:

Assessment and Evaluation
Grades in the course will be allocated based upon performance on homework assignments and a course project and presentation. Specifically, the weights for the course assessments are homework – 45%, project – 40%, presentation – 15%. Note that homework will be due a week after it is assigned. Cut-off points will be: 95 points A, 92-94 A-, 89-91 B+, 85-88 B, 82-84 B-, 79-81 C+, 75-78 C, 72-74 C-, 69-71 D+, 65-68 D, 62-64 D-, < 62 F.

The goal of the course project is to provide you an opportunity for additional exploration in the area of computational statistics. Specifically, the project can consist of either a Monte Carlo study of a statistical method (e.g., you can replicate published results or explore a gap in the literature), application of a statistical computing method to data, or further exploration of a statistical computing topic. You will have an opportunity to present your project at the end of the semester.

Some useful, although somewhat dated, resources for successful statistical presentations follow:


Incomplete grades: Incomplete grades (IW or IF) are not granted for low academic performance. To be eligible for an incomplete grade, students must: 1) successfully complete a minimum of 75% of the course, 2) have special circumstances beyond their control that preclude them from attending class and completing graded assignments, and 3) make special arrangements to complete missing work with the original instructor via completion of a CLAS course Completion Agreement. Verification of special circumstances is required. This agreement form is available from the CLAS Advising Office, NC 2024 or from the Department of Mathematics.

Disability Statement: Students with disabilities who need academic accommodations should contact the Office of Disability Resources and Services, 177 Arts Building, (303) 556-3450. The Office of Disability Resources will send a letter directly to me on your behalf indicating and detailing the accommodations particular to your case.
| Week 1  | 01/19-01/21 | T: Syllabus, Overview of Course  
R: Introduction to R topics for statistical computing |
|---|---|---|
| Week 2 | 01/26-01/28 | T: **Gentle 2**, generating random numbers, inverse transformation, acceptance/rejection method, transformations, convolutions, multivariate normal  
R: Simulating multivariate nonnormal distributions  
| Week 3 | 02/02-02/04 | T: Additional methods for simulating nonnormal multivariate distributions  
R: Gentle 2, Monte Carlo Markov Chains (MCMC), Gibbs sampler, Metropolis Sampler, Metropolis-Hastings  
| Week 4 | 02/09-02/11 | T: **Gentle 2**, Monte Carlo integration, variance reduction approaches  
R: Gentle 2, Generating null distributions  
| Week 5 | 02/16-02/18 | T: Review of unit root time series processes; Simulating critical values  
R: Gentle 10, Review/introduction to principal components; Simulating random eigenvalues for assessing dimensionality  
| Week 6 | 02/23-02/25 | T: **Gentle 2**, Monte Carlo methods for examining properties of statistical models and tests; impact of variable/scale coarseness on correlations  
R: Simulating regression models  
### Week 7
**03/02-03/04**
- **T:** Issues with measurement error, errors-in-variables regression
- **R:** Simulation extrapolation for correcting for measurement error

### Week 8
**03/09-03/11**
- **T:** Gentle 4. Bootstrap, Jackknife
- **R:** Gentle 4. Parametric bootstraps

### Week 9
**03/16-03/18**
- **T:** Introduction to models for panel data
- **R:** Clustered block-bootstrap for panel data

### Week 10
**03/23-03/25**
- **Spring Break**

### Week 11
**03/30-04/01**
- **T:** Gentle 3. Permutation tests
- **R:** Gentle 5, 10. Understanding structure, cluster analysis, principal components

### Week 12
**04/06-04/08**
- **T:** More on understanding structure
- **R:** *Society of Industrial and Organizational Psychology* – Alternate Activity

### Week 13
**04/13-04/15**
- **T:** Gentle 11. Regression trees, additional classification method
- **R:** Profile analysis

### Week 14
**04/20-04/22**
- **T:** Additional topics to be decided
- **R:** Presentations

### Week 15
**04/27-04/29**
- **T:** Presentations
- **R:** Presentations

### Week 16
**05/03-05/05**
- **T:** *American Educational Research Association* – Alternate Activity
- **R:** Presentations
Spring 2010 CLAS Academic Policies

The following policies pertain to all students and are strictly adhered to by the College of Liberal Arts and Sciences (CLAS).

- Every student MUST check and verify their schedule prior to the published drop/add deadlines. Failure to verify a schedule is not sufficient reason to justify a late add or drop later in the semester. It is the student’s responsibility to make sure that their schedule is correct prior to the appropriate deadlines.
- CLAS students must use their email.ucdenver.edu email address. Email is the official method of communication for all University of Colorado Denver business. All email correspondence will take place using your UCDHSC email address. Go to [http://www.ucdenver.edu/student-services/resources/registrar/students/policies/Pages/EmailPolicy.aspx](http://www.ucdenver.edu/student-services/resources/registrar/students/policies/Pages/EmailPolicy.aspx) to activate your email address.
- Students **are NOT automatically added** to a course off a wait list after wait lists are dropped. If a student is told by a faculty member that they will be added off the wait list, **it is the responsibility of the student to complete the proper paperwork to add a course**.
- Students **are not automatically notified** if they are added to a class from a wait-list. Again, it is the responsibility of the student to verify their schedule prior to any official dates to drop or add courses.
- Students must complete and submit a drop/add form to make any schedule changes. **Students are not automatically dropped from a class if they never attended, stopped attending or do not make tuition payments.**
- Late adds will be approved **only** when circumstances surrounding the late add are beyond the student’s control and can be documented independently. This will require a petition and documentation from the student. Please note that the signature of a faculty member on an add form does not guarantee that a late add petition will be approved. Petitions are available in NC 4011.
- Late drops will be approved **only** when circumstances surrounding the late drop have arisen **after** the published drop deadlines, are beyond the student’s control, and can be documented independently. This will require a petition and documentation from the student. Pre-existing circumstances (circumstances that existed prior to the published drop deadlines) regarding illness, work, family, or other confounding issues will not be considered adequate reason to drop or withdraw from courses after the published University and/or College drop deadlines. Please note that the signature of a faculty member does not guarantee that a late drop petition will be approved. Petitions are available in NC 4011.
- **Undergraduate students wishing to graduate in spring of 2010** must meet with their academic advisor by census date to obtain a graduation application. This application must be completed and submitted by 5 PM on February 3, 2010. You can obtain an application ONLY after meeting with your academic advisor. **There are no exceptions to this policy or date.**
- **Graduate students wishing to graduate in spring semester 2010** must complete their Intent to Graduate form and have a Request for Admissions to Candidacy on file with the CLAS Dean’s office no later than 5 PM, February 3, 2010.
- Students are responsible for completing financial arrangements with financial aid, family, scholarships, etc. to pay their tuition. Students will be responsible for all tuition and fees for courses they do not officially drop using proper drop/add procedures and forms.
- Students who drop after the published drop/add period will not be eligible for a refund of the COF hours or tuition.
Important Dates

- **January 19, 2010:** First day of Class
- **January 24, 2010:** Last day to add a class or be added to a wait list for a class using the SMART system.
- **January 25, 2010:** LAST DAY TO DROP WITHOUT DROP CHARGE – THIS INCLUDES SECTION CHANGES.
- **January 25, 2010:** Wait Lists are dropped. Any student who was not added to a course automatically from the wait list by this date and time MUST complete a schedule adjustment form to be added to the class. Students are NOT automatically added to the class from the wait list after this date and time. If your name is not on the official student roster, you are not registered for the course.
- **January 26-February 3, 2010:** Students are responsible for verifying an accurate spring 2010 course schedule via the SMART registration system. Students are NOT notified of their wait-list status by the university. All students must check their scheduled prior to February 3, 2010 for accuracy.
- **January 26, 2010:** First day instructor may approve request to add a student to a full course with a Schedule Adjustment Form.
- **February 3, 2010:** Census date.
- **February 3, 2010 at 5 PM:** Last day to add structured courses without a written petition for a late add. **This is an absolute deadline and is treated as such.** This deadline does not apply to independent study, internships, project hours, thesis hours, dissertation hours, and late-starting modular courses.
- **February 3, 2010 at 5 PM:** Last day to drop a spring 2010 course or completely with draw from all spring 2010 courses using a schedule adjustment form with a tuition adjustment minus the drop charge and no transcript notation – this includes section changes. Drops after this date will appear on your transcript. **This is an absolute deadline and is treated as such.**
- **February 3, 2010 at 5 PM:** Last day to request pass/fail or no credit option for a course.
- **February 3, 2010 at 5 PM:** Last day to for a graduate student to register for a Candidate for Degree.
- **February 3, 2010 at 5 PM:** Last day for a Ph.D. student to petition for a reduction in hours.
- **February 3, 2010 at 5 PM:** Last day to apply for spring 2010 graduation. You must make an appointment and see your academic advisor before this date to apply for graduation if you are an undergraduate; you must complete the intent to graduate and candidate for degree form if you are a graduate student.
- **February 15-24, 2010:** Faculty can use the early alert system.
- **March 22-28, 2010:** Spring break (no classes/campus open)
- **April 2, 2010 at 5 PM:** Last day for non CLAS students to drop or withdraw from all classes without a petition and special approval from the student’s academic Dean. **After this date, a dean’s signature is needed.**
- **April 16, 2010 at 5 PM:** Last day for CLAS students to drop or withdraw from all classes with signatures from the faculty and Dean without a petition. **This is treated as an absolute deadline.**
- **After April 16, 2010** all schedule changes require a full petition. Petitions are available in NC 4011.
- **May 10-15, 2010:** Finals Week
- **No schedule changes will be granted once finals week has started. There are NO exceptions to this policy.**