Introduction to Statistical Computing - STAT 445/645

Fall 2018—DMSC 106—Mon,Wed 2:30pm - 3:45pm

Instructor:	A. Grant Schissler	**Contact**:	aschissler@unr.edu, 775-784-4661 (office)
Office:	DMSC 224	**Hours**:	Tue 2:30pm-3:30pm, Wed 1:30pm-2:30pm, or by appointment

Computational skills have become an invaluable asset in our increasingly quantitative world. This course introduces students to the foundational skills and concepts needed in modern statistical and mathematical computing, with an emphasis on high-level programming languages and statistical applications.

There are three main parts to the course: First, students learn basic programming skills, graphics, and how to carry out basic statistical analyses (e.g., regression) all in R. Second, students learn the fundamentals of simulation techniques (Monte Carlo) for generating synthetic data. Third, students are introduced to various topics in computational statistics for estimation, integration, hypothesis testing, and density estimation for univariate and multivariate models.

Additionally, we'll briefly cover high-performance computing and document creation. This include parallel computing on desktops and/or on the Math server Okapi and the use R Markdown and LaTeX. This course will primarily use R, but may introduce some BASH shell (LINUX) commands/scripting and Bayesian computation in STAN.

Catalog Description

Introduction to statistical computing; data visualization and manipulation; document creation; graphics; simulation techniques; parallel computing; estimation; optimization; advanced statistical methods.

Course Pre-requisites

STAT 352 or STAT 467/667 or with instructor approval.

400-level Student Learning Outcomes

UG1 Students will be able to implement statistical simulation, re-sampling techniques, and maximum likelihood estimation.

UG2 Students will be able to conduct a simulation-based power analysis.

UG3 Students will be able to write professional quality reports and computer code.

600-level Student Learning Outcomes

GRAD1 Students will be able to use statistical computing methods to complete a research project and effectively communicate their findings.

Textbooks

None required. Supplementary texts:

- Rizzo, M. *Statistical Computing With R*. 2008, Chapman & Hall/CRC.

- Grolemund, G., Wickham, H. *R for Data Science*. 2016, OReilly.(Free at http://r4ds.had.co.nz/)

- The R Cookbook, by Paul Teetor

- The R Graphics Cookbook, by Winston Chang

- The Art of R Programming: A Tour of Statistical Software Design, by Norman Matloff

- Data Manipulation with R, by Phil Spector

- Software for Data Analysis: Programming with R, by John Chambers (advanced book)

- Efron, Bradley, and Trevor Hastie. *Computer age statistical inference*. Vol. 5. Cambridge University Press, 2016.

Online resources

- Course website: http:www.grantschissler.com/teaching/FA18/STAT445, includes a working course schedule and approximate due dates of assignments and exams.

- Course github repo: http:github.com/grizant/STAT445

- Students are responsible for checking Web Campus (http:wcl.unr.edu) and their email accounts, and are assumed to be aware of all information posted to these sources prior to each meeting.

Assignments

Exercises will be assigned approximately weekly. You are encouraged to discuss assignments between each other and with instructor. However, the works must be completed and submitted individually.

Exam policy

You will be allowed at one 8.5x11in page of handwritten (on both sides) notes for each midterm and three such pages for the final exam. If you believe that your grade for exam or assignment is incorrect, contact instructor at the office hours with a rational justification. All such requests must be submitted to instructor within one week after a grade is announced; late requests will not be granted. The final decision about new grade is made by the instructor. Please understand that everyone can make a mistake, and that mistakes can go both ways: higher or lower than original grade.

Midterms

There will be two midterms, the first on Wednesday, September 26, and the second on Wednesday, October 31.

Final exam

A comprehensive final examination will be held on Wednesday, December 19, 12:10pm - 2:10pm, DMS 106.

400/600 Students

As indicated above, the student learning outcomes differ at the 400 and 600 levels. Assignments and exams for students enrolled at the 400 level and 600 level will also differ. Specifically, graduate students will be expected to complete more exercises and exercises of greater difficulty on assignments. Exams will be of higher difficulty. Students enrolled at the 600 level will also be required to complete a **term project** due December 12.

Makeup, Late Policy

Late assignments, exams, and projects will not be graded. Exceptions will be made when a student misses work due to documented (doctor's note) illness or other extraordinary situation, up to the discretion of the instructor. There will be no early or make-up exams. However, if you need to miss an exam due to participation in official university activities (including athletics and other sanctioned activities), you must make arrangements with the instructor at least two weeks prior to the exam in question. Since the late policy is rather strict, I will drop your lowest two grades in the "Assignments" category as a safety factor for emergencies.

Grading

The final grades will be determined using the following percentages:

Item	400-level	600-level		
Assignments	40%	40%	A	90-100
Midterm Exams	40%	20%	B	80-89
Final Exam	20%	20%	C	70-79
Term project	–	20%	D	60-69
			F	59 or below

The instructor reserves the right to deviate from the above percentages in special cases, including borderline cases (generally this could be $+$/- 3% points) may be given a $+$ or within the above intervals or increasing the letter grade.

Diversity Statement

The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the Universitys Equal Opportunity & Title IX Office at (775) 784-1547. Resources and interim measures are available to assist you. For more information, please visit http:www.unr.edu/equal-opportunity-title-ix.

Disability Statement

The Department of Mathematics and Statistics supports providing equal access for students with disabilities. Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the Disability Resource Center (PSAC 230, http:www.unr.edu/drc) as soon as possible to arrange for appropriate accommodations.

Academic Conduct

No laptops, cell phones, mp3 players, or other electronics are to be used for personal reasons in class. If you are being disruptive during class you will be asked to leave. Disruptions in this context include inadequate participation. You must come to class on time and stay until the end of lecture. Tardy students will not be admitted to class. Please visit http:www.unr.edu/student-conduct for our official student code of conduct.

Academic Success Services

A common habit among successful students is to seek help outside of the classroom. Your student fees cover use of the Math Center (784-4433 or http:www.unr.edu/mathcenter), Tutoring Center (784-6801 or http:www.unr.edu/tutoring-center), and University Writing Center (784-6030 or http:www.unr.edu/writing-center). These centers support your classroom learning; it is your responsibility to take advantage of their services.

University Recording Policy

Surreptitious or covert videotaping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

Academic Dishonesty

Cheating, plagiarism, or otherwise obtaining grades under false pretenses constitutes academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include canceling a students enrollment without a grade or giving an F for the assignment or for the entire course. For more details, see the University of Nevada, Reno general catalog.

Tentative course schedule

Week	Topic1	Topic2	Notes
1	Syllabus/expectations/tools	Basic data structures	
2	**Labor Day (no class)**	Indexing/Iteration	
3	Text manipulation	Lab	
4	Data frames and apply	Lab	
5	Review session	**Midterm 1**	
6	Data Viz	Lab	
7	Functions	Lab	
8	Simulation (Monte Carlo)	Lab	
9	Importing data	Lab	
10	Review session	**Midterm 2**	
11	Split-apply-combine/parallelization	Lab	
12	**Veteran's Day (no class)**	Fitting models/prediction	
13	Monte Carlo integration/inference	Lab	
14	Bootstrap/jackknife	Lab	
15	Optimization/Maximum likelihood estimation (MLE)	Lab	
16	Markov Chain Monte Carlo (MCMC)	Lab/**presentations**	
17		**Final exam**	