Introduction to Statistical Computing - STAT 445/645

Fall 2019—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/Wed 4pm-5pm, 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 computing, with an emphasis on high-level programming languages and statistical applications. Throughout, students will conduct sophisticated data analyses and create professional-grade, reproducible documents.

There are three main units to the course: First, students learn to program in R, from basic data structures and flow control to advanced, efficient coding schemes (including *parallelization*). Second, students learn data manipulation, exploration, and visualization skills. Third, students learn to conduct statistical inference through simulation (Monte Carlo) techniques and optimization of probabilistic functions.

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.
- Efron, Bradley, and Trevor Hastie. *Computer age statistical inference*. Vol. 5. Cambridge University Press, 2016.
- Grolemund, G., Wickham, H. *R for Data Science*. 2016, OReilly.(Free at http://r4ds.had.co.nz/)
- The R Cookbook, by Paul Teetor

Online resources

- Course website: http:www.grantschissler.com/teaching/FA19/STAT445, includes a working course schedule and resource links.
- Course github repo: http:github.com/grizant/STAT445 maintains and distributes the latest version of all documents (assignments, slides, instructional materials, etc.)
- DataCamp for online modules: https://www.datacamp.com/home
- WebCampus (http:wcl.unr.edu) handles course announcements, official assignments, work due dates, work submissions, grades, discussion (forum).
- Students are responsible for any information emailed to their accounts listed in MyNevada (https://unr.onecampus.com/).

Assignments

The instructor will assign online modules in DataCamp (approximately) weekly. Additionally, the instructor will assign roughly one "lab" assignment per week. These two types of assignments are categorized as "Assignments". Students will complete the online modules individually while lab assignments may be completed collaboratively. You are highly encouraged to discuss assignments between each other and with your instructor. However, the works must be completed and submitted individually. All assignment, submissions, due dates, and feedback (grading) will be handled via WebCampus.

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 (or via email) 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 re-grading and any new grade belongs to 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, October 3, and the second on Wednesday, November 7.

Final exam

There will be a comprehensive take-home final examination.

400/600 Students

As indicated above, the student learning outcomes differ at the 400 and 600 levels. Students enrolled at the 600 level are required to complete a **term project**. Graduate-level assignments include project milestones in addition to the assignment's 400-level requirements.

Makeup, Late Policy

I adhere to the University's Class Absence Policy. Additionally, late Datacamp online modules will receive a 50% point deduction (however, the last submission date is Sunday, December 8, 2019). Late "lab" assignments will not be graded. As a safety factor for emergencies, the instructor will drop your **lowest lab grade** and **lowest two grades** in the "Online module" category. Late project products (reports/presentations) will *not* be graded. Lastly, 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 one week prior to the exam in question. Exceptions *may* be made when a student misses work due to extraordinary situations, up to the instructor's discretion.

Grading

We'll use a point system to evaluate student learning. There are five categories of assignments. Table 1 shows the total points possible within each category before dropping any low scores.

Item	400-level	600-level
Online Modules (13)	130	130
Labs (10)	200	200
Midterm Exams (2)	120	120
Take-home final Exam (1)	100	100
Term project (1)	–	150
Total	550	700
After-drop Total	510	660

Table 1: Total points available within each assignment category.

The sum of all points earned determine the final letter grades, according to the thresholds listed in Table 2.

Letter grade	400-level	600-level
A ($\geq 90\%$)	459 or above	594 or above
B ($\geq 80\%$)	408 to 458	528 to 593
C ($\geq 70\%$)	343 to 407	462 to 527
D ($\geq 60\%$)	306 to 342	396 to 461
F ($< 60\%$)	305 or below	395 or below

Table 2: Conversion table between points and letter grades, after dropping the two lowest "Assignments" grades.

The instructor reserves the right to deviate from the above thresholds, including assigning $+$ or $-$.

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

Any student with a disability needing academic adjustments or accommodations is requested to speak with the Disability Resource Center 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.

Pack Provisions

ASUN Pack Provisions strives to support all members of the University with daily resources they need to ensure success. This mission is carried out by providing access to basic necessities to students in need such as food, school supplies, hygiene items and more. To utilize this service, visit ASUN Center for Student Engagement on the Third Floor of the Joe Crowley Student Union or email packprovisions@asun.unr.edu.

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. See the University Academic Standards policy: UAM 6,502.

Tentative course schedule

Week	Unit	Monday	Wednesday
1	1: R Programming	Course structure/R/RStudio/RMarkdown/git	Data structures in R
2	1: R Programming	**Labor Day (no class)**	Conditionals, flow
3	1: R Programming	Loops, functions, apply	Lab
4	1: R Programming	Writing functions (advanced)	Lab
5	1: R Programming	Writing efficient R Code (e.g., PARALLEL)	Lab
6	1: R Programming	Review session	**Midterm 1**
7	2: Working with data	Importing data	Lab
8	2: Working with data	Cleaning data	Lab
9	2: Working with data	Exploratory Data Analysis (EDA)	Lab
10	2: Working with data	Data viz/grammar of graphics (GGPLOT2)	Lab
11	2: Working with data	Review session	**Midterm 2**
12	3: Statistical inference	**Veteran's Day (no class)**	Simulation/probability
13	3: Statistical inference	Monte Carlo integration/randomization tests	Re-sampling (Bootstrap)
14	3: Statistical inference	Maximum likelihood estimation (MLE)	Lab
15	3: Statistical inference	Markov Chain Monte Carlo (MCMC)	Lab
16	3: Statistical inference	Review/**project presentations**	**Prep day (no class)**
17	All		**Final exam due**