STAT 451: Statistical Software Development

Instructor: **email:**

Office Hours:

Credit Hours: 3

Required Materials:

- Advanced R (Wickham), available online for free at https://adv-r.hadley.nz/

Prerequisites: Stat 351, Stat 302

Course Description: Advanced statistical software development. Packaging code into functions, intelligent software design, compiled languages to speed up code, development and release cycles, and more. Students will develop a software package which fills a need in the statistics ecosystem and, by the end of the semester, will release the finished package to give back to the community.

Course Goals:

- Use of advanced computing techniques, including assessment of procedures via simulation under violated model assumptions
- Advantages and disadvantages of scripting and compiled languages for different problems
- How to effectively parallelize computations, and when the overhead for parallelization is worth it
- Software design considerations such as unit testing, code release cycles, profiling and optimization tools, and documentation tools
- Basic automation tools and their use in statistical programming
- Software package design and implementation in a statistical computing language

Grading:

Assignment(s)	Contribution to Final Grade
Package proposal	25%
Homework and blog posts	25%
Rough draft of package	25%
Final package and presentation	25%

Grading Scale:

Grade	Final Percentage Range
A	94.0-100
A-	90.0-93.99
B+	88.0-89.99
B	84.0-87.99
B-	80.0-83.99
C+	78.0-79.99
C	74.0-77.99
C-	70.0-73.99
D+	68.0-69.99
D	64.0-67.99
D-	60.0-63.99
F	<60.0

ACE Outcome 10 Generate a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.

STAT 451 will provide the student opportunities to achieve this outcome through development of a software package designed to address a statistics or data-related task. The package will contain appropriate documentation, tests, a vignette to demonstrate its use and application to a real-world problem, and a webpage to present the package to the wider statistical community. At the end of the course, the package may be submitted to an appropriate repository or made available online to contribute to the statistical software ecosystem.

Course Expectations: In this course, you are expected to have professional behavior. You are expected to attend all class meetings, be curious, ask questions, seek opportunities to learn, and be open and responsive to constructive feedback. In addition:

- Be an active participant–statistics is not a spectator sport!
- Be committed, take your work seriously
- Engage with the in-class activities and homework sets
- Help others–if you understand the material being discussed, practice your mentoring skills. This does not means sharing answers, but instead helping others understand the concepts.
- Complete assigned readings.

You are also expected to exhibit a professional demeanor (language, attitude) toward others. Disagreement during discussions is welcome and often productive in developing a deeper understanding of the concepts being discussed. However, disagreement does not warrant yelling or disrespectful language or behavior. Unprofessional behavior will not be tolerated, and appropriate actions will be taken to prevent future occurrences.

Package proposal: Package and proposal requirements will be provided to students by the 2nd week of class. The package proposal must make an argument for the need which is not currently

addressed by other packages, compare the proposed functionality to similar packages in the relevant software ecosystem, and outline the approach the package will use to address the problem.

Homework and blog posts: Between 8 and 10 homework assignments and blog posts will be assigned throughout the semester to reinforce material presented in class. Blog posts may ask students to respond to articles about software development practices or other topics relevant to lecture material.

Rough draft of package: A rough draft of the package, with major functions working, will be due during week 11 of the semester. Students will peer evaluate other packages, examining implementation, documentation, and usability.

Final package and presentation: Students will present their packages to the class, demonstrating essential functions and uses for the package in practical settings. Peer evaluations of the presentation and final package will be factored in to the final grade.

Emergency Response:

- Fire Alarm (or other evacuation): In the event of a fire alarm: Gather belongings (Purse, keys, cellphone, N-Card, etc.) and use the nearest exit to leave the building. Do not use the elevators. After exiting notify emergency personnel of the location of persons unable to exit the building. Do not return to building unless told to do so by emergency personnel.
- Tornado Warning: When sirens sound, move to the lowest interior area of building and seek shelter. Stay away from windows and stay near an inside wall when possible.
- Active Shooter
  - Evacuate: if there is a safe escape path, leave belongings behind, keep hands visible and follow police officer instructions.
  - Hide out: If evacuation is impossible secure yourself in your space by turning out lights, closing blinds and barricading doors if possible.
  - Take action: As a last resort, and only when your life is in imminent danger, attempt to disrupt and/or incapacitate the active shooter.
- UNL Alert: Notifications about serious incidents on campus are sent via text message, email, unl.edu website, and social media. For more information go to: unlalert.unl.edu.
- Additional Emergency Procedures can be found here: emergency.unl.edu.

Tentative Course Outline:

Week	Topics
1	Package development tools and environment; components of a software package
2	Code life cycles, unit testing
3	Profiling and optimization tools, human efficiency vs. computer efficiency
4	Documentation tools (roxygen)
5	Extending scripting languages with compiled functions (C, C++, basics of C++ programming)
6	Package proposal due; simulation strategies
7	Software technical documentation, vignette and tutorial writing
8	Other topics determined by student interest
9	Package work and debugging
10	Other topics determined by student interest
11	Rough draft of package due, peer evaluations of drafts
12	Other topics determined by student interest
13	Other topics determined by student interest
14	Final package due, package presentations
15	Package presentations