TEXAS
The University of Texas at Austin

EDP 380C 28: Statistical Modeling and Simulation in R

Unique: 12565

Spring 2025

Lecture	Tuesday and Thursday 9:30 AM – 11:00 AM
Location	SZB 5.414
Credits	3 credits

Instructor	Dr. Man Chen
Pronouns	She/her/hers
Office	SZB 5.308L
Email	man.chen@austin.utexas.edu
Office hours	Thursday, 11:00 AM – noon or by appointment

Course Description

EDP 380C 28 Statistical Modeling and Simulation in R introduces the Monte Carlo simulation methods, statistical computing, and advanced programming techniques in R. This course is designed for students with proficiency in R who wish to advance their R programming skills for statistical simulations, advanced data analysis, computing, and debugging. The course will focus on designing and implementing Monte Carlo simulation studies in R for formal methodological research (e.g., evaluation of statistical methods) and empirical applications (e.g., power analysis). Students will also learn advanced programming concepts such as functional and object-oriented programming. In addition, the course will introduce the R package and Shiny app development with GitHub integration.

Pre-requisites

- EDP 380C.26 Data Exploration and Visualization in R or equivalent
- EDP 380C.12 Survey of Multivariate Methods or equivalent

Learning Outcomes

By the end of this course, students will be able to do the following:

1. Understand the logic and mechanics of designing simulation studies using the R programming language.
2. Design and conduct Monte Carlo simulations.
3. Understand advanced programming concepts and techniques in R.
4. Use GitHub integration for package development and collaboration.

Course Requirements and Grading

Required Textbook

- Designing Monte Carlo Simulations in R by Miratrix & Pustejovsky (2024) Designing Monte Carlo Simulations in R

Additional Recommended Resources

- R programming for Data Science by Peng (2022) R Programming for Data Science
- R for Data Science: Import, Tidy, Transform, Visualize, and Model Data by Wickham, Cetinkaya-Rundel, & Grolemund (2e) R for Data Science (2e)
- R packages: Organize, Test, Document, and Share your code by Wickham & Bryan (2e) R Packages (2e)
- Advanced R by Wickham (2e) Advanced R

Statistical Computing

We will use the R environment (R and R studio) for software demonstrations and class activities.

Please bring your laptop for class activities (e.g., labs).

R: https://www.r-project.org

RStudio: https://www.rstudio.com

Getting Help with Technology

Students needing help with technology in this course should contact the ITS Service Desk.

Classroom Expectations

- **Class attendance** [Other than normal emergency accommodations, in-person attendance is required. In the event that you must miss a class, please notify me in advance with a legitimate reason. You will be responsible for the materials and announcements that you missed. Missing a class without an advanced notice/reason would result in a deduction in the attendance.]
- **Class participation** [Student participation is an integral component of this course and your feedback is important to me. Class participation is not included in the course grade but I strongly encourage you to participate actively in class activities and discussions. There will

be pre-course survey given in the beginning of the semester and a mid-semester survey. These surveys provide opportunities for you to share your learning experience which will help me tailor the course content and course instruction so that everyone can learn as much as possible.]

- **Respectful learning environment** [Please be respectful to each other and maintain a healthy learning environment in all course activities. Any concern in this regard should be brought to the attention of the instructor.]

Artificial Intelligence

Generative AI is a powerful tool for coding and students in the class may use ChatGPT or other generative AI tools. However, generative AI tools are not yet flawless and should be used with caution. If you use a generative AI tool for lab questions or assignments, you should describe how you used it (e.g., providing question as a prompt and use the code ChatGPT produced as a starting point, or providing both the question and your code and use ChatGPT for debugging).

Assignments

Throughout the course, students will conduct a comprehensive simulation project that involves programming at least a small Monte Carlo simulation using R. Students may choose one of the following two options for the course project:

- A replication of a published Monte Carlo simulation study. Note that if the source code of the replicated simulation study is accessible online, you are expected to update the data generating model, the estimation procedures, the experimental design, the performance criteria, and the demonstration of simulation results.
- An original Monte Carlo simulation study in the sense of not having been previously completed.

Students are required to discuss with the instructor which option they choose and what study they will work on. To better prepare students for the course project, there will be three assignments which are important components of the project. Details on the assignments will be explained during class and posted on Canvas. Some tentative details on each assignment are as follows:

- **Assignment 1**: Submit a project proposal that describes which of the aforementioned two options you choose, the context and motivation for conducting a Monte Carlo simulation, the research question(s) that the simulation study investigates, and a few key references. If you are only replicating part of a study, be sure to make it clear which parts you are focusing on.
- **Assignment 2**: Submit the data-generating model(s) used in the study, the estimation

methods, and the performance criteria. You will be required to provide code and output demonstrating that the data-generating functions and the estimation functions are correct.

- **Assignment 3**: Describe the design of the simulation conditions and provide the remaining code to implement the simulation. Conduct the simulation for at least one condition across replications. Characterize the amount of Monte Carlo error in the simulation results. Report the results of the simulation.

Evaluation & Grading

- **Class attendance (5%)**
- **Class labs (30% = 10 * 3%)**
    - There will be 10 graded class activities (i.e., labs) with each accounting for 3% of the final grade. Lab exercises will be given on Thursdays and due on Sundays of the same week unless otherwise specified. Students may discuss the questions with others, but the responses should be their own work (e.g., write their own code).
- **Assignments (30% = 3 * 10%)**
    - Each of the three assignments accounts for 10% of the final grade. Assignments will be submitted and graded through Canvas. Students may discuss the homework assignments with others.
- **Final project (35%)**
    - **Presentation (10%)** Each student is expected to present their project during the last two days of class. For the presentation, please prepare a 12- to 15-minute talk about your project, structued as if you were presenting at a conference. Briefly, state the problem, the importance and motivation for a simulation, the data-generating model(s), the estimation methods, the experimental design, the performance criteria, and the simulation results.
    - **Paper (25%)** The final document of your project will be the completed simulation work written in an academic style consistent with the major publication outlet of your study. Here you should add the results section, the discussion, and the reference list. The paper should tell a coherent story with the conclusions linking to the introduction via what was learned from the simulation analyses –- as if you are submitting it for publication. The final document will be due by Thursday, May 1st, 2025.

Late Work

Unless arrangements are made with the instructor in advance, a late lab or assignment will not be accepted. A justified request for a delay includes medical or family emergencies. There is no makeup assignments for missed work.

Extra Credit

There will be extra credit options in the final project document. Details will be given later this semester.

Grade Breaks

A tentative rubric for assignment of final grades is provided below. The instructor reserves the right to modify the rubric.

Grade	Cutoff
A	93%
A-	90%
B+	87%
B	84%
B-	80%
C+	77%
C	74%
C-	70%
D+	67%
D	64%
D-	60%
F	<60%

Sharing of Course Materials Is Prohibited

No materials used in this class, including, but not limited to, lecture hand-outs, exercises, labs, in-class materials, and additional problem sets, may be shared online or with anyone outside of the class without the explicit, written permission from the instructor. Unauthorized sharing of materials may facilitate cheating. The University is aware of the sites used for sharing materials, and any materials

found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in initiation of the student conduct process and include charge(s) for academic misconduct, potentially resulting in sanctions, including a grade impact.

Academic Integrity Expectations

Students who violate University rules on academic misconduct are subject to the student conduct process. A student found responsible for academic misconduct may be assigned both a status sanction and a grade impact for the course. The grade impact could range from a zero on the assignment in question up to a failing grade in the course. A status sanction can include a written warning, probation, deferred suspension or dismissal from the University. To learn more about academic integrity standards, tips for avoiding a potential academic misconduct violation, and the overall conduct process, please visit the Student Conduct and Academic Integrity website at: http://deanofstudents.utexas.edu/conduct.

Religious Holy Days

By UT Austin policy, you must notify me of your pending absence for a religious holy day as far in advance as possible of the date of observance. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Course Outline & Tentative Schedule

All instructions, assignments, readings, rubrics and essential information will be on the Canvas website at utexas.instructure.com. Check Canvas regularly. **Changes to the schedule may be made at my discretion if circumstances require**. I will announce any such changes in class and will also communicate them via a Canvas announcement. It is your responsibility to note these changes when announced, and I will do my best to ensure that you are notified of changes with as much advance notice as possible.

MP: Designing Monte Carlo Simulations in R

WCG: R for Data Science

Peng: R Programming for Data Science

WB: R Packages

Wickham: Advanced R

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Week	Dates	Topics & Readings	Assignments & Notes
Week 1	1/14, 1/16	Introduction, Structure of a Monte Carlo simulation study *Readings*: Syllabus, MP Chapters 1 & 4	Pre-course survey
Week 2	1/21, 1/23	Programming preliminaries *Readings*: MP Chapter 2; WCG Chapter 4, 25, 26, & 27; Peng: Chapters 13, 14, & 16; Wickham: Chapter 9	**Class cancelled due to UT closure (1/21)** Lab 1, Assignment 1 given (1/23)
Week 3	1/28, 1/30	Generating random numbers *Readings:* Peng: Chapter 20; MP: Chapter 6; Canvas readings	Lab 2
Week 4	2/4, 2/6	Data generation for regression models Readings: Peng: Chapter 20; MP: Chapter 3 & Chapter 5; Canvas readings	Lab 3, Assignment 1 due (2/9)
Week 5	2/11, 2/13	Generating multilevel data *Readings:* MP: Chapter 6; Canvas readings	Lab 4, Assignment 2 given (2/11)
Week 6	2/18, 2/20	Data generation for structural equation models *Readings:* Canvas readings	Lab 5
Week 7	2/25, 2/27	Estimation procedures *Readings:* MP: Chapter 7 & 8, Canvas readings	Lab 6
Week 8	3/4, 3/6	Performance criteria; Experimental design *Readings:* MP: Chapter 9 & 12	Assignment 2 due (3/9)
Week 9	3/11, 3/13	Presenting and writing simulation results *Readings:* MP: Chapter 15, Canvas readings	Lab 7, Assignment 3 given (3/11)
Week 10	3/18, 3/20	Spring break; no classes	
Week 11	3/25, 3/27	Using simulation as a power calculator *Readings:* MP: Chapter 22	Lab 8
Week 12	4/1, 4/3	Git and GitHub, R package development *Readings:* GitHub Docs, WB book chapters	Lab 9, Assignment 3 due (4/6)
Week 13	4/8, 4/10	Object-oritented and metaprogramming *Readings:* Wickham Chapters 12-21	Lab 10
Week 14	4/15, 4/17	Shiny app development *Readings:* Shiny for R	
Week 15	4/22, 4/24	Class presentations and wrap-up	Presentation due (4/24) Paper due (5/1)

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How Will You Learn?

Teaching Modality Information

This is a fully in-person course and class meetings will be held in-person throughout the semester. As such, in-person attendance is required, other than normal emergency accommocations. There will be no course recording.

Communication

The course Canvas site can be found at utexas.instructure.com. All the readings, lecture notes, assignments, quizzes, and announcements are posted on Canvas. You are responsible for ensuring that the primary email address you have recorded with the university is the one you will check for course communications because that is the email address that Canvas uses.

Asking for Help

Learn as much as possible. You're welcome to ask questions during class. If there is not enough time, please come to my office hours on Thursdays 11:00 AM – noon. If you can't make it to the office hours, please make arrangements with me in advance.

University Policies and Resources for Students

Disability & Access (D&A)

The university is committed to creating an accessible learning environment consistent with university policy and federal and state law. Please let your instructors know if you experience any barriers to learning so they can work with you to ensure you have equal opportunity to participate fully in your courses. If you are a student with a disability, or think you may have a disability, and need accommodations please contact Disability & Access (D&A). Please refer to the D&A website for more information. If you are already registered with D&A, please deliver your Accommodation Letter to your instructors as early as possible in the semester so you can discuss together your approved accommodations and needs in your courses.

Title IX Reporting and Support Disclosure

The Title IX Office uses information provided in reports to reach out to individuals in need, provide them with support and resources, and discuss options available to them related to a formal grievance process. For students, examples of support include academic accommodations, safety support, and connection with other campus and community resources.

Texas Education Code, Section 51.252 requires all employees of Texas universities, including faculty, to report to the Title IX Office any information regarding incidents of sexual harassment, sexual assault, dating violence, or stalking that is disclosed to them. Texas law requires that all employees who witness or receive information about incidents of this nature (including, but not limited to, written forms, applications, one-on-one conversations, class assignments, class discussions, or third-party reports) must report it to the Title IX Coordinator. Before talking with me, or with any faculty or staff member about an incident of this nature, please be aware that I will be required to report this information.

Graduate teaching and research assistants are also designated as mandatory reporters and are required to report behaviors that are considered sexual misconduct, including the types of misconduct described above.
Pregnant and parenting students, faculty and staff are also eligible to receive support and resources from the Title IX Office. Support and resources may include supportive measures, medically necessary periods of leave, and leaves of absence. Case managers from the Title IX Office connect with students, faculty, and staff to provide one-on-one, individualized support. If you would like to speak with a case manager for support, please email: supportandresources@austin.utexas.edu.
For more information about reporting options and resources, please visit the Title IX website, contact the Title IX Office via email at: titleix@austin.utexas.edu, or call 512-471-0419.

Names and Pronouns

Class rosters are provided to the instructor with the student's legal name, unless they have added a chosen name with the registrar's office.

- For instructions on how to add your pronouns to Canvas, visit this site.
- If you would like to update your chosen name with the registrar's office, reference this guide.
- For additional guidelines on changing your name on various campus systems, see the Resources page under UT Resources here.

Counseling and Mental Health Center (CMHC)

We all benefit from support during times of struggle. Remember, you are not alone. If you are experiencing signs of stress, anxiety, depression, academic concerns, loneliness, difficulty sleeping, or any other issues affecting your well-being, we encourage you to contact the Counseling and Mental

Health Center. The center is conveniently located on campus and provides a wide range of mental health services to all UT students. These services include support through assessment and referral, group and individual counseling, psychiatry, crisis services, and access to valuable well-being resources. In addition, CARE Counselors available within each academic school and college understand the unique concerns of their respective students and offer tailored assistance. Also, TimelyCare is a virtual mental health platform offering 24/7 support, scheduled counseling, psychiatric services, health coaching and self-care content. For more information, visit the CMHC website.

University Health Services (UHS)

Your physical health and well-being are a priority. University Health Services is the on-campus medical facility providing medical care and patient education to UT students. Services offered include general medicine, specialty clinics including the gynecology clinic, sports medicine, nutrition services, allergy, immunization and travel health, physical therapy, urgent care, a 24/7 nurse advice line; STI screening; and lab, x-ray, and ultrasound services. For additional information, visit the UHS website or call 512-471-4955.

Sanger Learning Center (SLC)

Did you know that over one-third of UT undergraduate students use the Sanger Learning Center yearly to strengthen their academic performance? All students can take advantage of Sanger Center's classes and workshops, private learning specialist appointments, peer academic coaching, public speaking, and tutoring for more than 70 courses in over 15 subject areas. For more information, please visit the SLC website (JES A332).

Dean of Students - Student Emergency Services (SES)

Our staff help students and their families during difficult or emergency situations. Assistance includes outreach, advocacy, intervention, support, and referrals to relevant campus and community resources. If you need to be absent from class due to a family emergency, medical or mental health concern, or academic difficulty due to crisis/emergency, and your instructor requires confirmation of your absence, we can help. We will document your situation and notify your instructors. Visit the SES wesbite to learn more, or call 512-471-5017 to speak with our staff.

Behavior Concerns and Advice Line (BCAL)

If you have concerns about the safety or behavior of fellow students, TAs, professors, or anyone at UT Austin, BCAL (the Behavior Concerns Advice Line) can help. Anyone can call BCAL (512-232-5050) 24/7 to share a concern about a UT person, or to get advice on how to talk with the person

about your concern. More information and an online report form are available on the BCAL website. Callers can remain anonymous, and confidentiality will be maintained as much as possible, however the university may be required to release some information to appropriate parties.

UT Outpost and Student Emergency Fund

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to visit UT Outpost for support. UT Outpost is the free on-campus food pantry and career closet for all currently enrolled UT students. Any student in need is encouraged to visit UT Outpost (2609 University Avenue, 3.108) for free groceries, personal care items, and gently-used professional clothing for interviews, internships, or other needs. To learn more, visit the UT Outpost website.

The Student Emergency fund exists to provide financial support when a verified emergency has impacted a student's health, safety, or wellbeing. An emergency is an urgent, sudden, and serious event that necessitates immediate action to remedy harm to life, health, or property. To learn more about eligibility or apply, visit the Student Emergency Fund website.

Important Safety Information

Carrying of Handguns on Campus

Students in this class should be aware of the following university policies related to Texas' Open Carry Law:

- Students in this class who hold a license to carry are asked to review the university policy regarding campus carry.
- Individuals who hold a license to carry are eligible to carry a concealed handgun on campus, including in most outdoor areas, buildings and spaces that are accessible to the public, and in classrooms.
- It is the responsibility of concealed-carry license holders to carry their handguns on or about their person at all times while on campus. Open carry is NOT permitted, meaning that a license holder may not carry a partially or wholly visible handgun on campus premises or on any university driveway, street, sidewalk or walkway, parking lot, parking garage, or other parking area.

Campus Safety

The following items are recommendations regarding emergency evacuation from the Office of Emergency Management, 512-232-2114:

- Students should sign up for Campus Emergency Text Alerts at the Office of Emergency Management.
- Occupants of buildings on The University of Texas at Austin campus must evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.
- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- For more information, please visit the Office of Emergency Management.