# STAT:7400 Computer Intensive Statistics
# Spring 2025

**Lectures MWF 11:30 AM –12:20 PM** 30 SH


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| **Teaching Assistant** | Qian Tang, qian-tang@uiowa.edu |
| **Department** | Statistics & Actuarial Science, 241 SH. http://www.stat.uiowa.edu |
| **DEO** | Professor Kung-Sik Chan, DEO, 319-335-0712, kung-sik-chan@uiowa.edu |


**Course Website.**
Announcements, homework problems, lecture notes, etc: http://icon.uiowa.edu.

**Course Schedule.**
Important dates and deadlines are posted on the following Google Sheet:
https://docs.google.com/spreadsheets/d/10-MLORXEdDlnoVhdgLpPvp_a_GdkaNc-1m_S-E-hVVE/edit?usp=sharing

**Course Description and Objectives.**
This course is designed for graduate students in statistics and data science. The goal is to develop advanced skills, knowledge, and tools useful in applying modern computationally intensive statistical methods to research in any field. Topics will be selected from design and analysis of simulation experiments, Markov chain Monte Carlo, optimization, machine learning, and deep learning. Other advanced topics may be covered if time permits.

This course is primarily in both R and Python, along with some exposure in C/C++. Extensive experience about writing R and Python packages is expected.

A substantial portion of materials in this course are adapted from Professor Tierney's previous teaching.
https://homepage.stat.uiowa.edu/~luke/classes/STAT7400-2023/_book/

**Prerequisites.**
STAT:5400.

**Textbook.**
No required textbook.

Optional Reference:

- Maria L. Rizzo (2008). *Statistical Computing with R.* Chapman & Hall/CRC.

- Trevor Hastie, Robert Tibshirani, and Jerome H. Friedman (2009). *The elements of statistical learning: data mining, inference, and prediction*. The 2nd Edition, New York: Springer.
  `https://hastie.su.domains/ElemStatLearn/printings/ESLII_print12.pdf`

- Norman Matloff (2011). *The Art of R Programming: A Tour of Statistical Software Design.* No Starch Press.

- Hadley Wickham and Grolemund Garrett (2016). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data.* O'Reilly Media, Inc.
  `https://r4ds.had.co.nz/`

- Rafael A. Irizarry (2019). *Introduction to Data Science.* Chapman & Hall/CRC.
  `https://rafalab.github.io/dsbook/`

**Grading.**
Your semester grade will consist of the following components:

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| Homework | 50% |
| Computing Project | 40% |
| Competing Project | 10% |
| Total | 100% |

As a *rough* guide, **A,A-**$= 90\% - 100\%$, **B+,B,B-**$= 80\% - 90\%$, **C+,C,C-**$= 70\% - 80\%$, **D+,D,D-**$= 60\% - 70\%$. A grade of **A+** represents very exceptional work and is given only in extraordinary situations.

There is no exam in this course. The homework and the computing projects are individual works. You may discuss general issues and approaches with your fellow students, but your work must be your own. See details below. Throughout this course, if you use any references, including solutions to similar problems prepared by other students, you **must** cite and credit your sources.

**Homework.**
Homework assignments consisting of a mix of computational and theoretical problems will be posted on ICON roughly on every other Friday. Exceptions to this schedule will be announced in class.

Some problems will cover material not addressed in class and may require additional reading. Suggested reading will also be posted on the class web site when appropriate, but you should also seek out and explore relevant references on your own. Homework should be submitted electronically through the ICON submission tools (`https://icon.uiowa.edu`) or GitHub.

Show your work when solving written homework problems. Complete code and output must be submitted for computer problems. Always document your answer. Many

students find that these assignments take a long time to complete, so plan your time accordingly.

You are strongly encouraged to study with others as teamwork is an important component of a statistician/data scientist. However, if you work with others on homework, please: a) write up your own assignment and make sure you completely understand all solutions that you submit, and b) write the names of the others in your study group on your assignment.

Note your write-up must be your own. Do not use solutions from previous years.

Late homework is accepted only as required by the university policy, i.e. due to "illness, mandatory religious obligations, or other unavoidable circumstances or University activities." This is a strict rule; however, you are allowed to drop the lowest homework grade.

**Office Hours.**
8:30 AM – 11:30 AM Wednesday

Ask questions if you are confused or think a point needs more discussion. Questions can lead to interesting discussions.

**Computing Project.**
Students registered for this class are required to complete a computing project. You should work on this project on your own. Your project should represent at least **40 hours** of work with high quality on a topic of your choice.

You should start to think about the topic as soon as possible. Your project must contain some new ideas with creativity. Below are some ideas:

- **Methodological**: Improve an existing method and support your conclusion with numerical evidence. It is totally acceptable that your proposal fails to outperform the benchmark baselines.
- **Computing**: Produce a new R or Python package. Try to argue why your package brings something new. Ideally you can publish your R package on The Comprehensive R Archive Network (CRAN). `https://cran.r-project.org/web/packages/` or your Python package on Python Package Index (PyPI) `https://pypi.org/`.
- **Applied**: You may analyze an interesting data set using a relatively new method related to ideas introduced in the class. You are expected to justify why your analysis is novel and comprehensive.

There are many possible choices for the topic of your project. Identifying a suitable topic is an important part of your task. The project should represent new work, **not something you have done for another course or as part of your thesis**. Note that this course brings you a gold opportunity to take risk of attempting some ideas

that may fail to work, so feel free to be creative in this project.

The computing project will be carried out in three stages.

- **Computing Project Proposal**. Due at 11:30 AM on Mar 12. The proposal has a one-page limit (not strictly enforced). This is a detailed description of what you plan to do, including questions to be addressed, software to be used, and methods to be investigated or applied, etc.
- **Computing Project Midterm**. Slides are due by noon on Mar 23 (Sunday). Individual sessions will be scheduled during the week following the spring break to provide personalized feedback on your slides and presentation. You will give a 15-minute presentation on Apr 14, Apr 16, or Apr 18, with focus on the background, proposed approach, and preliminary results. You should include one to two slides detailing a concrete plan for the next steps to be completed before the final presentation.
- **Computing Project Final Showcase**. You will deliver a final presentation that includes a brief review of the background and motivation and a showcase of your final results. The slides outlining your future plan from the midterm presentation must also be included in the final presentation.

**Competing Project.**
You will work in a group of three or four, depending on the final enrollment of this course, on a real-world data competition. You can choose a competition from Kaggle `https://www.kaggle.com/competitions` or any other similar competition you are interested in.

The Competing Project Plan is due on Feb 10. The plan should simply include your team members and which competition you will attend. All the teams will showcase your results on May 2.

**Attendance.**
Attendance is required. Please email the instructor if you are going to be absent from class. See instruction for Absence from Class due to illness, emergence, or extenuating circumstances in `https://registrar.uiowa.edu/absence-class` .

See COVID-related questions in `https://coronavirus.uiowa.edu/`.

A student who is absent for more than five days may request the UI Service Center, 17 Calvin Hall, `registrar@uiowa.edu`, to notify me of the reason for the absence.

Students with UI-authorized activities must discuss their absences with the instructor as soon as possible. Religious obligations must be communicated within the first three weeks of classes. See also Exam Policies.

**Copyright.**
The lectures, slides, homework, quiz and exam questions are for use only by students attending STAT:7400 (0001). It is illegal to share with anyone else the course materials without instructor's permission. See also Sharing of Class Recordings

**Academic Honesty and Misconduct**
All students in CLAS courses are expected to abide by the CLAS Code of Academic Honesty. Undergraduate academic misconduct must be reported by instructors to CLAS according to these procedures. Graduate academic misconduct must be reported to the Graduate College according to Section F of the Graduate College Manual.

**Student Complaints**
Students with a complaint about a grade or a related matter should first discuss the situation with the instructor and/or the course supervisor (if applicable), and finally with the DEO (Chair) of the department, school or program offering the course. Sometimes students will be referred to the department or program's Director of Undergraduate Studies (DUS) or Director of Graduate Studies (DGS).
Undergraduate students should contact CLAS Undergraduate Programs for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS Associate Dean for Graduate Education and Outreach and Engagement when additional support is needed.

**Drop Deadline for this Course**
You may drop an individual course before the deadline; after this deadline you will need collegiate approval. You can look up the drop deadline for this course here. When you drop a course, a "W" will appear on your transcript. The mark of "W" is a neutral mark that does not affect your GPA. Directions for adding or dropping a course and other registration changes can be found on the Registrar's website. Undergraduate students can find policies on dropping and withdrawing here. Graduate students should adhere to the academic deadlines and policies set by the Graduate College.

**Communication: UI Email**
Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community. For the privacy and the protection of student records, UI faculty and staff can only correspond with UI email addresses.

**Where to Get Academic Support for This Course**
Instructors: Remind students here about your drop-in student hours and also provide information on departmental, collegiate, or university resources helpful for this course, such as the Writing Center `https://writingcenter.uiowa.edu` or the Tutor Iowa central academic support site `https://tutor.uiowa.edu/`.

**Mental Health Resources and Student Support**

Students are encouraged to be mindful of their mental health and seek help as a preventive measure or if feeling overwhelmed and/or struggling to meet course expectations. Students are encouraged to talk to their instructor for assistance with course-related concerns. For additional mental health support, please see the guidance and resources at `mentalhealth.uiowa.edu`, including the 24-7 UI Support and Crisis Line.

Additionally, the Office of the Dean of Students can help students navigate personal crisis situations. They can provide one-on-one support, help with identifying options, and access to basic needs resources (such as food, rent, childcare, etc.). Student Care and Assistance: 132 IMU, `dos-assistance@uiowa.edu`, or 319-335-1162 and more info: `dos.uiowa.edu/assistance`.

**Accommodations for Students with Disabilities**
The University is committed to providing an educational experience that is accessible to all. If a student has a diagnosed disability or other disabling condition that may impact the student's ability to complete the course requirements as stated in the syllabus, the student may seek accommodations through Student Disability Services (SDS). SDS is responsible for making Letters of Accommodation (LOA) available. The student must provide an LOA to the instructor as early in the semester as possible, but requests not made at least two weeks prior to the scheduled activity for which an accommodation is sought may not be accommodated. The LOA will specify what reasonable course accommodations the student is eligible for and those the instructor should provide. Additional information can be found on the SDS website.

**University Policies**
Basic Needs and Support for Students
Classroom Expectations
Exam Make-up Owing to Absence
Free Speech and Expression
Mental Health
Military Service Obligations
Non-discrimination
Religious Holy Days
Sexual Harassment/Misconduct and Supportive Measures
Sharing of Class Recordings