ECON 390: Economic Applications of Data Science

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Course Description

ECON 390 is intended to provide a broad-based introduction to numerical and data-science methods commonly used in economics. The course will first introduce students to the R programming language, assuming no prior experience. Subsequent lectures, using R, will provide students an opportunity to apply this knowledge on real-world data to achieve an economic objective. The methods used in these applications will include (but are not limited to): collecting, cleaning, merging, processing, and visualizing data, descriptive analysis, optimization, and supervised/unsupervised statistical learning. In addition, the course has an experiential component that connects students with industry leaders in economic applications of data-science through a series of on-campus events.

Course Goals

My teaching goals for this course are as follows:

1. Teach students how to competently program in R with good style,
2. Teach students how to think and approach problems from a computational perspective,
3. Teach students basic data science skills including data visualization and basic models,
4. Imbue students with a desire to learn more about econometrics and data science.

Learning Objectives

Upon successfully completing ECON 390, students should be able to do the following:

1. Be able to write functioning, readable, and aesthetically pleasing code in the R programming language,
2. Given raw data, be able to manipulate the data into the correct format needed for an analysis,
3. Given data and a research question, be able to create a exploratory data visualization in the right format to get at answering the question,
4. Be able to communicate results to a non-technical audience.

Prerequisites

ECON 101 and economics major.

Course Materials

- **Recommended Supplemental Textbooks:** I will be pulling readings from various free textbook online.
  - *Learning R* by Richard Cotton (RC)
  - *R for Data Science* by Hadley Wickham and Garrett Grolemund (WG)
  - *Hands-On Programming with R* by Garrett Grolemun (G)
  - *An Introduction to Statistical Learning with Applications in R* by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani (JWHT)
- **Sakai:** All announcements, materials, assignments, grades, etc will be posted on the course's Sakai site. Please visit **sakai.unc.edu**. However, I will also be posting all materials on the Github repository for the course. You may access them however you wish, but assignments will need to be submitted on Sakai.
- **R and RStudio:** We will be using R as our primary programming language of choice for this class. R is a great language to learn on and has an excellent Integrated Development Environment (IDE) called RStudio. To install R, go to **https://cran.r-project.org** and download the correct distribution for your machine. After installing R, you can install Rstudio by going to **https://www.rstudio.com/products/rstudio/download/** and downloading the free version of RStudio Desktop.

Course Content

The course will cover the following topics using illustrative economic applications. While this is the broad outline of the course, the exact details are subject to change based on interest and background.

Module 1: Introduction (week 1)

- Introduction to course and syllabus

- Accessing computational resources on campus
- Identify groups and project topics

Module 2: R programming (weeks 2-5)

- arithmetic, loops, logic, vector/matrix operations
- optimization

Module 3: Data Acumen (weeks 6-9)

- Structured and unstructured data
- Loading, cleaning, validation, merging, and processing data
- Data scraping

Module 4: Data Science and Visualization (weeks 10-15)

- Descriptive analysis
- Visualizing and plotting data (spatial, etc)
- Clustering, classification, etc

Assessments

The following items will contribute to your overall grade:

- Problem Sets (60%): total of five homework assignments counting equally. Assignments are due at 11:59 PM on the due date. late assignments will receive a score of zero.
- Participation (10%): regular participation in class discussions and attendance at speaker events. If you have a persistent illness or another reason to be consistently missing class, please reach out to me. I want you to be successful in the course.
- Final (30%): in groups of 5 or less, students will present their findings on an economic application of data science (of their choosing) during the scheduled final time. More details on this to come.

The typical UNC grading scale will be used. I reserve the right to curve grades if needed, but it will only ever be in the benefit of the student. If g is your numerical grade, letter grades will be assigned as follows:

- A: $93 \leq g \leq 100$, A-: $90 \leq g < 93$
- B+: $87 \leq g < 90$, B: $83 \leq g < 87$, B-: $80 \leq g < 83$
- C+: $77 \leq g < 80$, C: $73 \leq g < 77$, C-: $70 \leq g < 73$
- D+: $65 \leq g < 73$, D: $60 \leq g < 65$
- F: $g < 60$

Course Policies

During Class

It is strongly encouraged that you bring a computer to every lecture and be programming along with me and the slides. The only way you learn programming is by doing. I've heard some mathematicians say that math is not a spectator sport. While that is definitely true for math, it is even more true for programming. In order to learning how to program, you have to program! So please, follow along with me during lecture.

Communication Channels

Feel free to contact me with any questions. I will respond as soon as possible. Please write your email in a professional manner with a greeting, body, and closing statement. When addressing me, "Alex" is fine. I am not a professor (only a graduate student), and I am not yet a doctor.

Regrade Policy

Regrading request must be sent via email within 72 hours of assignment grade release.

Attendance Policy

As participation is a part of your grade, attendance is *required*. Not attending lecture will hurt both your grade and your understanding of the course. If you have a University Approved Absence, please let me know so that we can make plans accordingly

Mask Use

This semester, while we are in the midst of a global pandemic, all enrolled students are required to wear a mask covering your mouth and nose at all times in our classroom. This requirement is to protect our educational community — your classmates and me – as we learn together. If you choose not to wear a mask, or wear it improperly, I will ask you to leave immediately, and I will submit a report to the Office of Student Conduct. At that point you will be disenrolled from this course for the protection of our educational community. Students who have an authorized accommodation from Accessibility Resources and Service have an exception. For additional information, see Carolina Together.

Academic Integrity and Honesty

You are required to follow the UNC Honor Code as stated. If you are unfamiliar with the honor code, please see me or visit: **https://catalog.unc.edu/policies-procedures/honor-code/**. Any violations of the honor code will be reported accordingly.

Accommodations for Disabilities

UNC accommodates reasonable requests for students with learning disabilities, physical disabilities, mental health struggles, chronic medical conditions, temporary disability, or pregnancy

complications, all of which can impair student success. See the ARS website for contact and registration information: **https://ars.unc.edu/about-ars/contact-us**.

Counseling and Psychological Services

CAPS is committed to addressing the mental health needs of the UNC community. Please do not hesitate to reach out: **https://caps.unc.edu**

Discrimination and Title IX

I value the perspectives of individuals from all backgrounds reflecting the diversity of our students. I broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. I strive to make this classroom an inclusive space for all students. Please let me know if there is anything I can do to improve, I appreciate suggestions.

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Please contact the Director of Title IX Compliance (Adrienne Allison - **Adrienne.allison@unc.edu**), Report and Response Coordinators in the Equal Opportunity and Compliance Office (**reportandresponse@unc.edu**), Counseling and Psychological Services (confidential), or the Gender Violence Services Coordinators (**gvsc@unc.edu**; confidential) to discuss your specific needs. Additional resources are available at safe.unc.edu.

Preferred Name & Preferred Gender Pronouns

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

Additional Resources

- **The Learning Center:** The UNC Learning Center is a great resource both for students who are struggling in their courses and for those who want to be proactive and develop sound study practices to prevent falling behind. They offer individual consultations, peer tutoring, academic coaching, test prep programming, study skills workshops, and peer study groups. If you think you might benefit from their services, please visit them in SASB North or visit their website to set up an appointment: **http://learningcenter.unc.edu**.
- **EconAid Center:** Additional help can be obtained through the EconAid Center. More information can be found at **https://econ.unc.edu/undergraduate/econaid/**.

Syllabus Changes

The professor reserves the right to make changes to the syllabus, including project due dates and test dates. These changes will be announced as early as possible.

Important Dates

Please check the registrar's page for important dates: add/drop, breaks, course final, etc.

- Wednesday, August 18, 2021: First Day of Class
- Tuesday, August 24, 2021: Last Day for Late Registration
- Tuesday, August 31, 2021: Last Day to Drop Class (No Record)
- Monday, September 6, 2021: Labor Day - No Class
- Thursday, October 14, 2021: Last Day to Drop Class (On Record)
- Thursday, October 14, 2021: Last Day to Declare P/F
- Thursday, October 21, 2021 - Friday, October 22, 2021: Fall Break
- Wednesday, November 24, 2021 - Friday, November 26, 2021: Thanksgiving Break- No Class
- Wednesday, December 1, 2021: Last Day of Class
- Thursday, December 9, 2021: Final Exam Time