Master of Science in Applied Economics
University of Maryland-College Park
Washington, DC location: 1400 16th Street, NW, suite 140
Fall 2022

Syllabus: ECON 687 – Economic Applications of R Programming

Instructor: Chris Adams (cadams21@umd.edu) Teaching Assistant: Zhenxun Liu (zliu1995@umd.edu)

Office Hours: Wednesday 5:45 - 6:30p . TA Office Hours: Tuesday 5:00 - 6:00p

Co-requisites: ECON 645

Class meets: Thursday 6:45 - 9:30, 15 min break at 8:15.

General Description and Overview

This course builds on the data analysis and econometric skills learned in the Empirical analysis sequence of ECON 643, 644, and 645. The STATA skills acquired in that sequence, such as basic data manipulation and econometric estimation, will be extended to the R programming language. The fundamentals of more advanced scientific programming—objects, data structures, dictionaries, loops, functions, simulation, parallel computing—will be introduced with applications to economics and the social sciences. Additional emphasis is placed on good coding practices.

Learning Outcomes

Our program has 7 general learning outcomes for students:

1. Ability to understand, evaluate and analyze economic data
2: Ability to understand and interpret statistical evidence from economic data
3: Ability to apply empirical evidence to assessing economic arguments
4: Ability to apply macroeconomic theories to policy discussions
5: Ability to apply microeconomic theories to policy discussions
6: Ability to communicate economic ideas to a broader audience
7: Ability to evaluate the effectiveness of policy programs using sound economic techniques

The learning outcomes that pertain to this course are: 1, 2, 3, 5, 6 and 7

Students will generalize existing knowledge of STATA to R. Students will establish basic competency in scientific programming tools and concepts in R. Students will be able to compose readable, professional code.

Course Website: Copies of the course syllabus, your grades, and other relevant links and documents will be posted on the course's ELMS/Canvas website. You can access the site via www.elms.umd.edu. You will need to use your University of Maryland "directory ID" and password.

Email: The University has adopted email as the primary means of communication outside the classroom. Students are responsible for updating their current email address via http://www.registrar.umd.edu/current/ (under the first major heading of "Online Transactions" there is a link to "Update Contact Information").

You are required to pay attention to ELMS/Canvas Announcements I send to the class. You should make sure ELMS/Canvas Announcements and messages are forwarded to an email address that you check regularly. Failure to check email, errors in forwarding email, and returned email due to "mailbox full" or "user unknown" will not excuse a student from missing announcements or deadlines. I will do my best to respond to email within 36 hours. I prefer that

you contact me via email to cadams21@umd.edu, rather than through the ELMS/Canvas messaging system, though I will reply to either kind of message.

Required Textbooks
ADAMS: *Learning Microeconometrics with R* by Adams, Christopher, 1st edition.
MATLOFF: *The Art of R Programming* by Matloff, Norman, 1st edition.
Some additional readings will also be provided via the course's ELMS/Canvas website and syllabus hyperlink.

Required Statistical Software: R, RStudio
(All are free and setup information will be covered in the beginning of the course.)

Laptop Computer Requirement: Completing some of this course's requirements will require a laptop computer. Students must bring their computer to all meetings of this course.

12-week schedule
(revisions, if any, will be announced in class, by ELMS/Canvas Announcement, and posted in a revised syllabus online)

9/1 (Week 1): Introduction to the course
Download R and Rstudio
Basic programming in R
Run OLS and plot in R
Adams Introduction: Hello R World

9/8 (Week 2): Objects in R
Discussion of objects in R (vectors, matrices, lists, data frames)
OLS
Estimating the relationship between education and income.
Adams App. B: Objects in R, Interacting with Objects.
Matloff Ch. 1: Preview of Some Important R Structures
Matloff Ch. 2: Scalars, Vectors, Arrays and Matrices
Adams Ch. 1: Matrix Algebra of the OLS model
Card, *Using Geographic Variation in College Proximity*

9/15 (Week 3): Statistics in R
HW # 1 Due
Discussion of statistical functions in R
CLT
Student's middle finger analysis
Adams App B: Statistics
Matloff Ch. 8: Functions for Statistical Distributions
Adams App A: Central Limit Theorem
Student, *The Probable Error of a Mean*

9/22 (Week 4): Control in R
HW # 2 Due
Discussion of looping and if/else in R
Jackknife and Bootstrap
Inference on the relationship between education and income
Adams App. B: Control
Matloff Ch. 7: Control Statements
Adams Ch. 1: Measuring Uncertainty
Adams App. B: Bootstrap
Card, *Using Geographic Variation in College Proximity*

9/29 (Week 5): Functions in R

Paper Proposal Due
Discussion of functions in R.
Instrumental variables
Returns to education
Adams App. B: Functions
Matloff Ch. 1: Introduction to Functions
Matloff Ch. 7: Return Values
Adams Ch. 3: Instrumental Variables
Card, *Using Geographic Variation in College Proximity*

10/6 (Week 6): Optimization in R
QUIZ
Discussion of optimization methods in R
Maximum Likelihood
Adams App. B: Optimization
Adams Ch. 5: Maximum Likelihood

10/13 (Week 7): Simulation in R
HW # 3 Due
Discussion of Monte Carlo methods.
Estimating Auctions
Collusion in Timber Auctions
Matloff Ch. 8: Simulation Programming in R
Adams Ch. 9: Sealed Bid Auctions, English Auctions, Are Loggers Colluding?

10/20 (Week 8): Numerical Methods
First Draft of Paper Due
Numerical probabilities and derivatives
Multinomial Probit
Demand for Rail
Adams Ch. 5: Multinomial Choice, Demand for Rail

10/27 (Week 9): Empirical Bayesian Estimation
HW # 4 Due
Identification
Generalizing fixed effects
Returns to Schooling
Adams App. A: Bayesian Statistics, Empirical Bayesian Estimation,
The Sultan of the Small Sample Size
Koop and Tobias, *Learning about Heterogeneity in Returns to Schooling*

11/3 (Week 10): Machine Learning Methods: Regularization
HW # 5 Due
Scheduled Discussions of Paper Completed
Discussion of regularization methods.
Synthetic Control, LASSO
Effect of federal minimum wage on hours worked
Adams Ch. 11: Regularization, Returning to Minimum Wage Effects
Abadie et al, *Synthetic Control Methods for Comparative Case Studies*

11/10 (Week 11): Review
Final Draft of Paper Due
Discussion of factoring methods
Principal Components
Convex Factor Models
Effect of federal minimum wage on hours worked

Adams Ch. 11: Factor Models, Returning to Minimum Wage Effects
Hotelling, *Analysis of a Complex of Statistical Variables into Principal Components*

11/17 (Week 12): **Final Exam**

Graded Course Components

There are 6 graded components to the course. The 6 components and their relative weights in the course grade are: homework (30%), quiz (10%), online discussions (5%), in-class discussion (5%), the final exam (25%) and the course project (25%).

Homework (30 course points)

There will be 5 HW assignments. HW assignments will always be posted to the Assignments section of the course ELMS/Canvas page. Homework assignments will come largely from the textbook chapters that week. I will expect you to submit an R file that I am able to run from my own machine.

Each HW assignment will be worth some number of raw points. The proportion of points awarded on each assignment will be consistent with the final course grade scale below, with "A work" receiving 93%-100% of the possible points, and "B+ work receiving 80%-89% of the possible points, etc. The proportion of total course HW points (out of 30) will depend on the proportion of total raw HW points earned. So a student who has earned 86% of all the possible raw HW points will receive 25.8 of the 30 possible course HW points (0.86*30 = 25.8). HW will be due at the beginning of class on the date listed above. Late HW will lose 1 raw course point for each 24 hours late.

Final Exam (25 course points)

I will prepare an exam that I think students should be able to solve in 2 hours, though students are welcome to use the entire class period from 6:45-9:30. The final exam will be cumulative. Most or all of the exam will consist of a series of empirical problems to be solved using R and submitted electronically. There may be additional questions on general programming concepts.

The final is open note, open book, open internet. Students can use whatever notes they like, including online resources. But students may not communicate with anyone except the proctor during the exam. Any student caught using a cell phone, email, or communicating with anyone in any way will receive a zero. Students who spend too much time leafing through books and web pages will run out of time.

Each question will be worth some number of raw points. The proportion of points awarded on each question will be consistent with the final course grade scale below, with "A work" receiving 93%-100% of the possible points, and "B+ work receiving 80%-89% of the possible points, etc. The proportion of total course exam points will depend on the proportion of total raw points earned on each exam. So a student who has earned 86% of all the possible raw Final Exam points will receive 21.5 of the 25 possible Final Exam points (0.86*25 = 21.5).

Quiz (10 course points)

I will prepare a quiz that will be taken in class. Like the final, this is an open quiz. The questions will be similar to the HW problems.

Course Project (25 course points)

Students will replicate findings from an empirical paper published in an economics journal with publicly available code and data. This will include a mix of econometric results as well as tables and data visualizations. Students are encouraged to pair up for this project. As described below, students will search for suitable papers and partners in the first 3-4 weeks of the course.

Crucially, students should also describe both the intuition and economic foundations of what they're replicating, and contextualize it within the rest of the paper.

Students will complete the course project work in 4 installments:

- Project proposal (2 points)
- Complete first draft of course project, including descriptive analysis (10 points)
- Follow-up and discussion of first draft feedback with me during scheduled office visit (3 points)

- Final draft of completed course project (10 points)

Each is due on the date listed above at the beginning of class on that date. Students will lose 1 course point for each 24 hours late.

Additional details will be provided in class and on the course's ELMS/Canvas website.
The proportion of points awarded on each component will be consistent with the final course grade scale below, with "A work" receiving 93%-100% of the possible points, and "B+ work receiving 80%-89% of the possible points, etc.

Online Discussions (5 course points)
In the first few weeks of the course, online discussion will consist of students posting links to papers which interest them as a candidate for the replication project. During this process, students with similar interests can pair up and decide on one paper to pursue together for the replication project. More generally, students are expected to use this to post questions about their project or present interesting charts or tables that come from the project. Each week I will assign teams to lead the discussion about their project. Students can then respond to questions and presentations with suggestions and follow up questions for the group. The weekly online discussions will be graded on a 5-point scale. The students will be graded for participation, for the quality of questions and responses posted.

In-Class Discussions (5 course points)
Students will participate in class with questions and suggestions about the material being covered. Students may also raise questions about their project related to the material covered in class. The participation will be graded on a 5-point scale.

Final Course Letter Grades

At the end of the semester I will add up each student's course points. This will be a number between 0 and 100. I do not grade on a curve. Numerical course grades will be translated into letter grades as follows:

93-100	90-92	80-89	70-79	60-69	50-59	40-49	30-39	20-29	10-19	0-9
A	A-	B+	B	B-	C+	C	C-	D+	D	F

At my discretion, I might give an A+ to a student or two at the very top of the class' grade distribution.

Course Evaluations

Near the end of the term, you will receive an email inviting you to submit a voluntary and anonymous course evaluation. You will be able to submit your evaluation between November 7th and November 18th. Your feedback on courses will be very helpful in improving the quality of instruction in our program.

Standard Policies

Policies related to all graduate courses at the University of Maryland are posted on this page of the Graduate School's website:

https://gradschool.umd.edu/faculty-and-staff/course-related-policies

Please familiarize yourself with these policies related academic integrity, non-discrimination policy, accessibility, absences and accommodations, grading, academic standing, grievance procedures, and other important policies.

Contact Hours: Three credit master's-level courses at the University of Maryland require a minimum amount of contact between instructors and students. Our courses' 12 weekly meetings only satisfy 80% of the university's contact requirement. The other 20% is satisfied by weekly mandatory and graded online contact. In principle, the contact hours requirement could be satisfied by scheduling 3 additional 150-minute meetings per term, or 6 additional 75-minute meetings, or 10 additional 45-minute meetings. But in practice the contact hours requirement is satisfied by the weekly online discussion boards. The weekly online discussions are a more flexible way to ensure that our program's courses in DC provide the same level of student-instructor contact as the traditional 15-week face-to-face version of the same course when it is taught on campus in College Park.

Work Load: Mastering the material covered in this course requires a significant amount of work outside of class. Students should expect to spend more time outside of class than in class – typically at least twice as much time. The courses in our DC program are 12-week courses that cover all the same material as a traditional semester-long 3-credit course (15 weeks). The compressed schedule makes it possible to complete our degree in just 15 months if you take 2 courses each term. But the compressed schedule also implies an accelerated pace with an average of 25% more work per week in a given course (15/12 = 1.25). The normal full-time load in a master's program is 3 courses per semester, or 6 courses per year. The weekly work load when taking 2 of our DC courses per term is equivalent to the load from 2.5 "normal" 15-week courses - so 2.5/3.0=83% of a full-time load. Students who take 2 courses per quarter in our program complete 8 courses per year. So over the course of a year, taking 2 courses per quarter in our DC program is equivalent to 133% of a full-time load (8/6 = 1.33).

Academic Progress: The graduate school requires that students maintain a GPA of at least 3.0. Students whose cumulative GPA falls below 3.0 will be placed on academic probation by the graduate school. Students on academic probation must ask the program's director to petition the graduate school if they want to remain in the program. The petition must include a plan for getting the student's GPA up to at least 3.0. Students who do not live up to their plan can be forced to leave the program without having earned the degree. Note: a grade of "B" corresponds to a GPA of 3.0. A grade of "B-" corresponds to a GPA of 2.7.

Excused Absences: If you miss any class meetings for any reason, you are still responsible for all material covered during the meeting you missed. It is your responsibility to work with study partners, the teaching assistant, and the instructor to make sure you catch up on the missed material. Instructors routinely facilitate things by posting lecture notes, etc.

If you need to miss an exam or other graded course requirement because of illness, injury, or some other emergency: Follow doctor's orders and get documentation. Get in touch with the instructor as soon as you're able – preferably prior to missing the exam or deadline. Communicate with the instructor to make up the course requirement as soon as possible. You are entitled to recover before you make up the course requirement, but you are not entitled to extra days to study beyond the time the doctor's note says you've been incapacitated. If you are incapacitated for more than a week or so beyond the end of the term, your grade in the course will be an "Incomplete." In such cases you must negotiate a plan with your instructor for completing the course requirements. Once you make up the course requirement the instructor will change your "I" to the appropriate letter grade.

School Closings and Delays: Information regarding official University closing and delays can be found on the campus website and the snow phone line: (301) 405-SNOW (405-7669) The program director will also announce cancellation information to the program as an announcement on the program's ELMS/Canvas site. This will generally be done by 1:00 p.m. on days when weather or other factors are an issue. When classes need to be canceled during the semester, we make every effort to schedule makeup classes.

UMD Counseling Center: Sometimes students experience academic, personal and/or emotional distress. The UMD Counseling Center in Shoemaker Hall provides comprehensive and confidential support services that promote personal, social, and academic success. The cost of these services is covered by the fees you already paid when you registered for classes, and there is no additional charge if you use the services. Proactively explore the range of services available, including the Counseling Service, Accessibility and Disability Service, and the Testing Office, all described at http://www.counseling.umd.edu/

Graduate Academic Counselor: The UMD Graduate School also has an academic counselor available to support students who are having difficulty navigating mental health resources on campus, are considering a leave of absence and/or need assistance finding mental health care off campus. The Graduate Academic Counselor also facilitates bi-weekly Graduate Student Circle Sessions which provide an opportunity to learn about resources and connect with other graduate students. Students can learn more about the Graduate Academic Counselor by going to: https://gradschool.umd.edu/gradcounselor

Course Evaluations: Near the end of the term, you will receive an email inviting you to submit a voluntary and anonymous course evaluation. Your feedback on courses will be very helpful in improving the quality of instruction in our program.

Building Access: There is a smartphone app that can be used to enter our building after normal business hours. The program coordinator will provide information about this. We will also provide information about the code for entering the front door of our suite. Please make sure you are receiving the ELMS-Announcements that we send out to the program about these and other important matters.