

Master of Science in Applied Economics
University of Maryland-College Park
Washington, DC location: 1400 16th Street, NW, suite 140
Fall 2023

Syllabus: ECON 687 – Economic Applications of R Programming

Instructor: Chris Adams (cadams21@umd.edu)

Teaching Assistant: Jose Fellman

(fellman@umd.edu)

Office Hours: Monday 6:15 - 7:00p (Zoom)

TA Office Hours: Monday 5:15 - 6:15p (Zoom)

Prerequisites: ECON 645

Class meets: Tuesday 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)

8/29 (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

R for Data Science: <https://r4ds.had.co.nz/data-visualisation.html>

9/5 (Week 2): Objects in R

Discussion of objects in R (vectors, matrices, lists, data frames)

OLS and ggplot

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

R for Data Science: <https://r4ds.had.co.nz/data-visualisation.html>

9/12 (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

9/19 (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

9/26 (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*

10/3 (Week 6): Optimization in R

QUIZ

Discussion of optimization methods in R

Maximum Likelihood

Adams App. B: Optimization

Adams Ch. 5: Maximum Likelihood

10/10 (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?

10/17 (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

10/24 (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*

10/31 (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*

11/7 (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*

11/14 (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 ($0.86 \times 30 = 25.8$). 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 ($0.86 \times 25 = 21.5$).

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 in November (exact dates TBA). Your feedback on courses will be very helpful in improving the quality of instruction in our program.

Other Standard Policies for the Program and the University of Maryland

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. However, the DC program takes just 1 week off between terms. 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 "normal" full-time load in the traditional semester-based program ($8/6 = 1.33$).

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.

Academic Integrity: The University of Maryland has a nationally recognized Code of Academic Integrity. You should inform yourself about the UMD policies related to academic misconduct:

<https://www.studentconduct.umd.edu/home/current-students>

The exams in this course will ask students to affirm the UMD Honor Pledge: "I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination."

Cases of academic misconduct, including plagiarism and giving or receiving unauthorized assistance on exams, will be referred to the UMD Office of Student Conduct. If found responsible for academic misconduct, students can be subject to sanctions. The standard sanction for graduate students found responsible for cheating on exams is expulsion from the university.

Student Conduct: Students are expected to treat each other with respect. Disruptive behavior of any kind will not be tolerated. Students who are unable to show civility to one another or myself will be referred to the Office of Student Conduct. You are expected to adhere to the Code of Student Conduct.

Excused Absences: The University of Maryland's policy on excused absences is posted here:

<http://www.president.umd.edu/administration/policies/section-v-student-affairs/v-100g>

Please note:

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 – not the instructor's – 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're 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. If

classes need to be cancelled during the semester, it may be necessary to move the final exam back a week so missed classes can be made up.

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, Learning Assistance 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>

Students with Disabilities: The University of Maryland does not discriminate based on differences in age, race, ethnicity, sex, religion, disability, sexual orientation, class, political affiliation, or national origin. Reasonable accommodations will be arranged for students with documented disabilities. Students who have an accommodations letter from the Accessibility and Disability Service (ADS) should meet with me during the first few weeks of the semester to discuss and plan for the implementation of your accommodations. If you require reasonable accommodations but have not yet registered with ADS, please contact the Accessibility and Disability Service at 301-314-7682 or adsfrontdesk@umd.edu.

Building Access: The door to the building at 1400 16th Street is unlocked on weekdays until 7:00 PM. Students who arrive after 7:00 PM or on weekends will find the door locked. You can call the phone on the security guard's desk by dialing (202) 328-5158. If the security guard is off duty or happens to be away from his or her desk when you arrive, you can always also go around to the other door at 1616 P Street and pick up the black phone to the right of that door. You will be connected to the company that handles security for our building. If you tell them you're with the University of Maryland (suite 140 in 1400 16th Street), they should ask you for a password. When you tell them the password, they will buzz you in. You can get the password from the program coordinator, the TAs, or the program director. Please note: the building security staff are not able to buzz you in at the 1400 16th Street door. You have to go around to the 1616 P Street door to be buzzed in.