

## Econ 687: Economic Applications of R Programming (Fall 2024)

### 1.1 Instructors and Classes

Instructor Name: Christian Krestel  
Instructor email: [ckrestel@umd.edu](mailto:ckrestel@umd.edu)  
Class Meetings: Thursday 6.30-9.15 with a 15 min break around 8pm

Location: College Park, Main Campus  
**Tydings 2102**

Office Hour: Zoom, Sunday 09.30am-10.30am and by appointment

Link

<https://umd.zoom.us/j/95112273317?pwd=ZVVWNWEwVIE4NmVzTWFRYURoZ3NCUT09>

TA Name: Jaclyn Lee  
TA email: [jaclyn7@umd.edu](mailto:jaclyn7@umd.edu)  
TA Office hours: Wednesday 5:15-6.15pm, Morrill Hall and by appointment

**Autumn break:** No class on 11/28 (Thanksgiving recess)

### 1.2 Communication

The primary means of communication is email. Emails will be sent to @umd.edu addresses. You are responsible for regularly checking your @umd.edu address including announcements made via ELMS/Canvas. Please note that problems with your mailbox do no excuse missed deadlines or announcements.

I will try to answer your emails as quickly as possible. You are, however, also welcome to attend my office hour (via Zoom). You'll find the link above. Please send me an email before informing me that you want to attend!

### 1.3 Exams

Midterm: 10/17

Final: 12/12

### 1.4 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 will be extended to the R programming language. R is an open source statistical language, popular in economics, for which thousands of packages implementing a wide variety of econometric techniques are available. The fundamentals of more advanced scientific programming – data structures, loops, functions – will be introduced with applications to economics and the social sciences. Object oriented programming techniques and concepts will be discussed. Emphasis is placed on good coding practice and reproducible research using R Markdown.

**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](http://www.elms.umd.edu). You will need to use your University of Maryland "directory ID" and password.

## 1.5 Learning Objectives

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 1,2,3,6 and 7.

## 1.6 Textbook

This course uses various materials most of which are available online.

William N Venables et al.: An Introduction to R, 2021. Available at <https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf>

Hadley Wickham and Garret Grolemund: R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, 2017. Available at <http://r4ds.had.co.nz>

Florian Heiss: Using R for Introductory Econometrics, Second Edition 2020. Available at <http://www.urfie.net>

Rob J Hyndman and George Athanasopoulos: Forecasting: Principles and Practice, Third Edition 2021. Available at <https://otexts.com/fpp3>

Christopher Adams: Learning Microeconometrics with R, 1<sup>st</sup> edition

Norman Matloff: The art of R programming, 1<sup>st</sup> edition

Fred Nwanganga and Chapple, Mike: Practical Machine Learning in R

Brett Lantz: Machine Learning with R

## 1.7 Required software

This course requires installing R, Rstudio, and a Latex distribution (TinyTex, MikTeX,..; Lyx is a Latex WYSIWYG editor; texstudio is a good latex editor). Students need to create a GitHub account and synchronize it with Rstudio. All software is free and open source. We will go through the necessary installation steps at the beginning of the course. The basics of Git and GitHub are not covered in class. You are strongly encouraged to familiarize yourself with Git and GitHub while working on the course project and the homework assignments.

## **1.8 Course Outline (changes, if any, will be announced in class and via ELMS)**

Week	Date	Topic
1	08/29	Introduction into R; objects and object oriented programming; basic datatypes, conditional statements and for loops
2	09/05	For loops, Dataframes, Basic Plotting; Using R markdown <i>Project: Topics to be released</i> <i>HW 1 released</i>
3	09/12	Data wrangle I: tidyverse: dplyr, pipes, ggplot, data merging
4	09/19	Data wrangle II: Data table, formatting and outputting regression results <i>HW 1 submission, HW 2 released</i>
5	09/26	Factors and tables; Descriptive Statistics; Monte Carlo Simulation and Asymptotic
6	10/03	OLS; ggplot II, Mincer wage equation; standard error corrections <i>Project: Groups have been formed, submission of project proposals</i> <i>HW 2 submission</i>
7	10/10	Probit and Logit models; map, apply
8	10/17	Midterm
9	10/24	Panel data 1: simple pooled data, diff-in-diff <i>Project: First draft due, includes all descriptive stats</i>
10	10/31	Panel data 2: Fixed effects estimator, random fixed effects, dummy OLS <i>HW 3 released</i>
11	11/07	Instrumental Variables
12	11/14	Machine Learning I: Introduction and Terminology; Supervised Learning: Linear Regression, Logistic Regression, k nearest neighbor <i>Hw 3 submission, HW 4 released</i>
13	11/21	Machine Learning II: Variations on k nearest neighbor, Naive Bayes, Decision trees; Unsupervised Learning: Clustering
	<b>11/28</b>	<b>No Class – Thanksgiving Recess</b>
14	12/05	Machine Learning III: Unsupervised Learning: Association rules; Deep learning: Neural networks <i>HW 4 submission</i>
15	12/12	Final Exam <i>Project: Draft course project due</i>

## **2. Grading and related issues**

### **2.1 Types of evaluation:**

- (a) Exam: Midterm 27%, Final 27%
- (b) Assignments (4, 5% each, in total 20%)
- (c) Course project 10%
- (d) Presentation 6%
- (e) Quizzes: 2 quizzes in the term, each 5%, total 10%

**(a) Exams:** Midterm and Final at the above dates. See “Excused Absences” under “Other Policies” for permissible exceptions. All exams are in-person and proctored. No collaboration is permitted. The exam is open book.

**(b) Assignments:** There will be four assignments. All assignments must be submitted through ELMS. You may solve and discuss the assignments in groups, however, every student is required to submit an assignment of his/her own. You are also encouraged to discuss any problems/questions relating to the assignments with your TA. The schedule for the assignments is as follows:

	Release	Submission
HW 1	09/05	09/19
HW 2	09/19	10/03
HW 3	10/31	11/14
HW 4	11/14	12/05

Late submissions are not accepted.

### **(c) Course Project**

For the project students will replicate the findings of a paper published in an economics journal with publicly available data. Students should work in groups for this project (size to be determined during the term). You are required to reproduce the main results of the paper (tables) as well as visualize data. Apart from writing the necessary code in R, students should describe the intuition and econometric foundations of what they are replicating. A thorough discussion of the replication’s results is required, in particular of the reasons why a replication was successful or was not.

The final product is a zip file containing all code and data as well as a report. The code should be executable such that I can reproduce your results. (Please use relative rather than absolute paths). The report can be in a R Markdown file, however reports in Latex, Word are also accepted.

Timeline:

- Course week 2: Papers will be posted, students can start to choose papers;
- Course week 5: Groups have been formed, project proposal to be submitted including which descriptive statistic is to be performed, which tables will be replicated; submission via ELMS
- Course week 9: First draft due, includes complete descriptive statistics
- Course week 15: Final project due

### **(d) Presentation**

Each group will give a short presentation (max 20min) at some point during the term. The presentation will be about the work in progress on the course project. In general there will be one presentation per week, beginning in course week 9 (depending on the number of students). The presentation consists of an overview of the paper that is replicated and the discussion of some of the main results. Emphasis should be placed on a discussion of the R code written to replicate the project. A first draft of the presentation has to be submitted to [ckrestel@umd.edu](mailto:ckrestel@umd.edu) a week before the presentation. You will receive feedback that should be incorporated into your presentation.

**(e) Quizzes:** The two quizzes will take place on randomly chosen dates during the course. The emphasis of each quiz will be on the material of the last lecture. Since the course is cumulative, I will, however, assume that you are familiar with all the topics and programming techniques that we have seen before.

## 2.2 Grades

At the end of the term, every student will have a numerical course grade between 0 and 100. I will decide upon the numerical cutoffs between various letter grades based on my professional judgment. I will consider students' performance relative to the class. I will also consider absolute standards of professional competence. Highly competent students will get A's. Barely competent students will get B's. Grades of B-'s or worse indicate work that is below the minimum acceptable standards of our program.

The cutoffs that I use will respect the ordinal ranking of numerical course grades. No student with a given numerical course grade will receive a lower letter grade than someone else with a lower numerical course grade.

Observe that A+ may be given for exceptional achievement for the students at the top of the distribution.

## 3. 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.

**Workload:** 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. In a regular 15-week semester (as in the College Park version of our program): Taking 3 master's-level courses is supposed to approach the time commitment of a full-time job (~36-39 hours per week, so 12-13 hours per week per course). Taking 3 master's-level courses while simultaneously working at a demanding full-time job during the day is not advisable.

**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 who fail to bring their GPA up to at least 3.0 after a semester 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.

**Laptop Computer Requirement:** Completing some of this course's requirements will require a laptop computer (not a notebook or a tablet!) with at least 1 GB of RAM and at least 5 GB of free space available on the hard-drive. We recommend laptops with at least a 15-inch screen. Screens smaller than 13 inches are probably not practical.

**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>

**UMD Accessibility & Disability Service:** The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The Accessibility & Disability Service (ADS) provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact ADS as soon as possible so that they have sufficient time to make arrangements. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-

7682, or email them at [adsfrontdesk@umd.edu](mailto:adsfrontdesk@umd.edu). Information about sharing your accommodation letter, discussing accommodation logistics and getting assistance from ADS staff and more can be found on the ADS website.

**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.

**Access to Morrill Hall and Morrill 1102:** Morrill Hall is locked every day from 7:00 p.m. - 7:00 a.m. Your university ID gives you swipe access to the back door of the building. There is keypad access to the door of Morrill 1102. The code will be shared with students by the program coordinator.