



# UNIVERSITY OF MARYLAND

**Department of Economics**  
**Master of Science in Applied Economics Program**  
**ECON 687: Economic Applications of R Programming**  
Spring 2022

## Course Description

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, loops, functions—will be introduced with applications to economics and the social sciences. Additional emphasis is placed on good coding practices, reproducible research using **R Markdown**, and collaborative work using **GitHub**. Students are expected to know the econometrics concepts covered in ECON 643, 644, and 645.

## Class Meetings

Thursday evenings, 6:45–9:30 PM at 1400 16th Street, NW, suite 140

## INSTRUCTOR

Stéphane Verani

[sverani@umd.edu](mailto:sverani@umd.edu)

Office hours:

<https://umd.zoom.us/j/8430136371>,

Wednesday 5:15pm-6:15pm,  
or by appointment

## TEACHING ASSISTANT

Panos Dimitrellos

[panosdim@umd.edu](mailto:panosdim@umd.edu)

Office hours:

Tuesday 5:15pm-6:15pm, or  
by appointment

## Syllabus

### 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 collaboratively.

## Lectures

Each week, there are two in-person class meetings of 75 minutes each on Thursday, from 6:45 to 8:00PM and from 8:15 to 9:30PM. The weekly in-person meetings cover a particular theme with a mix of lecture materials and lab exercises. Starting from Week 2, students will be provided with an **R Markdown** file on which to take notes and complete tasks. **There is no class meeting during spring break (March 20-27). There is a make up class on Friday March, 18 from 6:45 - 9:30 PM.**

## Course Materials

The course covers selected materials from five publications:

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

Hadley Wickham and Garrett Grolemund *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data* (Paperback; O'Reilly Media, 2017). available here <http://r4ds.had.co.nz/>

Florian Heiss *Using R for Introductory Econometrics, Second Edition* (Florian Heiss, 2020). available here <http://www.urfie.net>

Florian Oswald et al. *Introduction to Econometrics with R*, 2020. available here <https://scpoecon.github.io/ScPoEconometrics/>

Rob J Hyndman and George Athanasopoulos *Forecasting: Principles and Practice, Third Edition* (OTexts, 2021). available here <https://otexts.com/fpp3/>

All are publically available online. That said, you may wish to purchase a hardcopy of Heiss (2020) for readability.

## Required software

This class requires installing **R**, **RStudio**, and a **LaTeX** distribution (**TinyTex** is recommended and can be installed from **R**). Students also need to create a **GitHub** account and synchronize it with **RStudio**. All are free and setup information will be covered in the beginning of the course and as part of the first homework assignment. The basics of **Git** and **GitHub** are not covered in class. Student will learn **Git** and **GitHub** on their own as part of their first homework assignment and the term project.

## Graded Course Requirements

Evaluation is by a combination of participation, term paper, and exam. There are 6 graded components to the course with the following relative weights: online discussions (5%), in-class discussions (5%), assignments (30%), course project (25%), presentation (10%), and the final exam (25%).

**Online Discussions (5%):** In the first few weeks of the course, online discussion will consist of students posting the paper which interests 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 the online discussion to post questions about their project, present interesting charts or tables that come from the project and discuss issues related to **GitHub**, **R** and **RMarkdown**. 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%):** Students will participate in class with questions and suggestions about the material being covered and during the various programming tasks. 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.

**Assignments (30%):** There are five homework assignments over the course of the semester. Homework assignments will be posted to the Assignments section of the course ELMS/Canvas page. Input data file will either be supplied or a description of where to obtain the dataset will be included in the assignment. Students are expected to submit an R Markdown file and the knitted output file in PDF. R Markdown is covered during the first homework assignment.

Assignments should be submitted through ELMS by 6PM on the due date. No late work will be accepted.

Each of the first four assignment is graded on a 10 points scale and each question specifies the number of points attached to it. The fifth assignment is graded on a 5 point scale and the points earned will be added to the total earned on the first four assignment—i.e., bonus points.

**Course project (25%):** Students will replicate findings from an empirical paper published in an economics journal with publicly available data. Students must pair up for this project and collaborate using **GitHub**. Learning the basic of **GitHub** and synchronizing **Github** with **R** and **RStudio** is part of the first assignment.

The replication exercise includes a mix of econometric results as well as summary tables and data visualizations. The instructor will post a google sheet with a list of papers after the second class and students can add their names to the paper that they would like to work on. The papers were selected because they include a complete replication package. That said, students are required to check that all the data they will need to complete their project is available when selecting the paper.

Aside from the programming work and collaboration in **GitHub**, students should also describe both the intuition and econometric foundations of what they're replicating, and contextualize it within the rest of the paper. Students should also discuss their replication results, whether and how their replication results differ from that of the original paper, and provide feedback about the original paper. Examples of reports and expectations will be provided in class and on the ELMS/Canvas website.

The final project consists of a **GitHub** repo containing a README file, all data and code necessary to run the analyses, as well as the actual written report in **R Markdown**.

Besides the project milestones that are a part of the Presentations as described below, students will complete the course project work in 4 installments (see the "Tentative Schedule" for due dates)

- Complete project proposal, indicating which descriptive analysis and main tables will be replicated (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 (15 points)

Additional details will be provided in class and on the course's ELMS/Canvas website.

**Presentation (10%):**

Each pair of students will give a short (15-20 minutes) presentation at some point during Week 9 through 11. The presentation will cover the work in progress on the course project. The presentations consist of an introduction to the paper being replicated, as well as discussion of a few results that the students have chosen to replicate. Students are expected to discuss some of the **R** code they have used in their replication project.

Students are required to send complete first drafts of their presentation to the instructor via email at [sverani@umd.edu](mailto:sverani@umd.edu) by noon on the Thursday before they present. The instructor will provide feedback by end of the following Friday. The actual presentation must include revisions that address the feedback. Final drafts of the presentaion are due at the same email address by 5:00 PM on Tuesday.

**Final exam (25%):**

There is a 2 hours 45 minutes in-person proctored final exam on May 19 from 6:45PM to 9:30PM. Students should bring their own laptop to the exam.

The exam should take approximtely 2 hours to complete and students can choose to use the entire exam time. The final exam is cumulative. Most or all of the exam consists 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. That said, 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 spending too much time leafing through books and web pages will probably run out of time.

Each question is worth some number of raw points. The proportion of total course exam points depends on the proportion of total raw points earned on each exam. For example, a student earning 86% of all the possible raw Final Exam points receive  $0.86 * 25 = 21.5$  final exam points.

**Final Course Letter Grades:** At the end of the semester the instructor will add up each student's course points. This will be a number between 0 and 100. This course is not graded 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 the instructor discretion, a student or two at the very top of the class' grade distribution may be awarded an A+.

## Course Schedule

### **Class 1 (3 Mar): Intro to R Part I**

Heiss (2020) Chapter 1  
Oswald et al. Chapter 1  
Venables et al. (2021) Chapter 1-6

### **Class 2 (10 Mar): Intro to R Part II**

Heiss (2020) Chapter 1  
Oswald et al. (2021) Chapter 1  
Wickham (2017) Chapter 19-21  
Venables et al. (2021) Chapter 8-10, 12-13

### **Homework 1 due**

### **Class 3 (17 Mar): Tidying, Visualising and Summarising Data**

Oswald et al.(2021) Chapter 2  
Wickham (2017) Chapter 2-16

### **Complete project proposal due**

### **Class 4 (18 Mar): Tidying, Visualising and Summarising US Census Data**

Oswald et al. (2021) Chapter 2  
Wickham (2017) Chapter 2-16

### **Class 5 (24 Mar): No Class – Spring Break**

### **Class 6 (31 Mar): Linear Regression Models**

Oswald et al. (2021) Chapter 3-6  
Heiss (2020) Chapter 2-9

### **Homework 2 due**

### **Class 7 (7 Apr): Causal inference Part I: Cross-Sectional Data**

Oswald et al. (2021) Chapter 7-11  
Heiss (2020) Chapter 15

## **Class 8 (14 Apr): Causal inference Part II: Panel Data**

Oswald et al. (2020) Chapter 12-13

Heiss (2020) Chapter 13-14

### **Homework 3 due**

## **Class 9 (21 Apr): Causal inference Part III: Instrumental Variables**

Oswald et al. (2020) Chapter 10-11

Heiss (2020) Chapter 15

## **Class 10 (28 Apr): Time series analysis / Project presentations**

Heiss (2020) Chapter 10-12

Hyndman et al. (2021) Chapter 3-4

### **Complete first draft of course project**

## **Class 11 (5 May): Introduction to forecasting / Project presentations**

Hyndman et al. (2021) Chapter 8-9

### **Homework 4 due**

## **Class 12 (12 May): Advanced topics, review / Project presentations**

### **Homework 5 due (bonus points)**

## **Class 13 (19 May): Final exam**

### **Final draft of completed course project**

## **Course Policies**

**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.

**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 need to use your University of Maryland "directory ID" and password.

**Email:** Email: The University has adopted email as the primary means of communication outside the classroom, and I will use it to inform you of important announcements. The University creates an “@umd.edu” email address for every graduate student. All official UMD communications will be sent to students at their “@umd.edu” email address. You are responsible for reading your @umd.edu email address, including 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. The instructor will do his best to respond to email within 36 hours.

**Standard 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-p>

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.

**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 workload 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:** 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:** 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.

**Please note:** If you miss any class meetings for any reason, you are responsible for working with the instructor to make sure you are caught up on the missed material. Instructors routinely facilitate things by posting lecture notes, etc.

**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 free, comprehensive, and confidential counseling / mental health services that promote personal, social, and academic success. All Counseling Center services are completely free for enrolled students. Proactively explore the range of services available at the Counseling Center, including the Counseling Service and Accessibility and Disability Service 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, by the Accessibility and Disability Service (ADS), which is a unit within the Counseling Center. Students who have an accommodations letter from the 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](mailto:adsfrontdesk@umd.edu).

**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 the 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.

**Covid-19 Information:** Up-to date information about UMD Covid-19 policies and guidance are posted at <https://umd.edu/4Maryland>. Given the evolving nature of the pandemic, the guidance and policies are subject to change. The plans are always coordinated with state and county health officials, with additional guidance provided by the University System of Maryland. The focus will always be on the health and well-being of our entire campus community.

We strongly urge all students, staff and faculty to read announcements they receive about Covid-related guidance and policy, and to stay familiar with the information posted at <https://umd.edu/4Maryland>. We thank you all for your individual efforts to help protect the collective health of our entire community.

– This syllabus is subject to change –