Mathematics for Social Sciences and Basic Statistics

Program: Master in Social Sciences, Fall 2022
Room: 18.1.A04
Time: Monday, 19/09, 10:00–13:00 &
Monday, 19/09 – Friday, 23/09, 14:30–17:30

Contact Information

Instructor: Patrick Kraft, PhD
Office: 18.2.C.07
Email: patrickwilli.kraft@uc3m.es
Office Hours: Monday – Friday, 13:00–14:30, or by appointment.

I Overview

Course Description

This course is a mathematics boot camp to prepare you for subsequent social science methods courses in our MA program. Our task is to begin developing skills that social scientists use for the systematic analysis of society, politics, and people. In service of this ultimate goal, this course will provide students with an introduction to the mathematical foundations that form the basis of many methods used in the social sciences. By the end of the course students should have an understanding of basic mathematical operations, a familiarity with core mathematical concepts used in the social sciences, and a working knowledge of basic probability theory. For instance, we are going to cover topics such as basic calculus, static optimization theory, and linear algebra.

This course is not intended to be an introduction to game theory or quantitative methods as such. Rather, it introduces basic mathematics and computer skills needed for quantitative and formal modeling courses offered at UC3M. It prepares you, in particular, for your MA courses in the statistics sequence (Applied Quantitative Methods for the Social Sciences I & II), Political Economy, and Game Theory (and subsequent classes). Given sufficient time throughout the week, you are also going to be introduced to R (the statistical computing language used in the department's methods courses), RMarkdown, and LaTeX(a typesetting language useful for producing documents with mathematical content). These resources are very powerful, but some of them have a relatively steep learning curve, so one of the goals of the math camp is to give students a head start on these programs.

Structure & Grading

After an introductory session on Monday, September 19 from 10:00 to 13:00, the class will meet every weekday afternoon between 14:30–17:30 (19/09–23/09). The first half of each session will cover mathematical and theoretical concepts whereas the second half will focus on applications and assignments. Every day, there will be problem sets and exercises to work on during the sections (or as homework if not finished then). Students are encouraged to work on the exercises in groups of two or three. Given the introductory character of the course, the final grade will be based on the submission of exercises and activities that will be proposed at the end of each session. Further details will be discussed in class.

Prerequisites

This course has no formal prerequisites. The social sciences are an increasingly mathematical group of disciplines. Empirical social scientists will need to regularly draw on ideas from differential and integral calculus (and probably linear algebra as well). Social scientists who do formal theory will also need to be able to understand and derive mathematical proofs. There is no secret to mathematical training and everyone in this class is capable of learning all the math you need to be a successful social scientist. We're happy to talk with students at any point about their mathematical preparation, how they can catch up, or how to develop their skill sets further.

II Textbook and Additional Material

Required

There is one required textbook for the course. It is free of charge and available online:

King, Gary et al. 2020. "The Harvard Math Prefresher for Political Scientists."
https://iqss.github.io/prefresher/

Additional Readings (Optional)

In addition, you may want to consult some of the supplementary material listed here:

Moore, Will H, and David A Siegel. 2013. *A mathematics course for political and social research*. Princeton University Press. YouTube lecture available here: http://people.duke.edu/~das76/moosiebook.html

Gill, Jeff. 2006. *Essential mathematics for political and social research*. Cambridge University Press.

Sydsæter, Knut, and Peter J Hammond. 2016. *Essential mathematics for economic analysis*. 5th ed. Pearson.

Wainwright, Kevin et al. 2013. *Fundamental methods of mathematical economics*. 4th ed. McGraw Hill.

Simon, Carl P, and Lawrence Blume. 1994. *Mathematics for economists*. Norton & Company, Inc.

III Schedule

Day, Time	Topics	Textbook
Mon, 19/09, 10:00–13:00	Course Logistics, Basic Operations & Functions	ch. 1
Mon, 19/09, 14:30–17:30	Limits & Calculus	ch. 2-3
Tue, 20/09, 14:30–17:30	Optimization	ch. 4
Wed, 21/09, 14:30–17:30	Linear Algebra I	ch. 6
Thu, 22/09, 14:30–17:30	Linear Algebra II	ch. 6
Fri, 23/09, 14:30–17:30	Probability Theory	ch. 5

Note: Schedule may be subject to change depending on our progress during the week.

Class Pace

We understand that students come from diverse mathematical backgrounds. The class has an aggressive schedule, but we'll move to the next topic only if *every* student understands the material. The only way we'll know if students don't understand the material is if they ask questions. So questions are strongly encouraged! There are two ways to ask questions. First, students should always feel free to interrupt lectures with questions. These are the most important questions—they'll indicate that we need to slow down the course. Second, you can come to my office hour or send me emails to ask questions.

Note on Readings

Students should plan on reading the material before each class meeting. The chapters are mathematically challenging. The best way to read math text books is to work through the derivations with a pencil and paper close by. Working through the derivations and exercises will be very useful.

Feedback for Us

We continuously work on improving our math camp. At the end of math camp we will send an anonymous survey and ask you to give us feedback on what worked and what didn't in the camp. We're also receptive to feedback throughout the camp.