Mathematics for Political Science

Carlos B. Gueiros

Syllabus Fall 2022

E-mail: cgueiros@uni-mannheim.de

Office Hours: by appointment

Office: B 304

Web: math-refresher-22.netlify.app

Class Hours: See schedule

Class Room: B 317

Course Description

This course is designed to understand mathematical tools useful for the rest of your Master program, especially for the upcoming, mandatory courses in statistics and game theory. The course reviews some mathematical concepts most of you will be familiar with from high school, such as functions, derivatives, integrals, vectors, matrices and probability distributions. Each day consists of lectures and exercise sessions. The course's objective is to make students familiar and comfortable with notation, reading mathematical statements, and applying various mathematical techniques.

Attendance Policy

While the instructor strongly encourage attendance, this course is voluntary. If you decide to participate I expect you to attend the class actively and full time each session.

Class Schedule

Date	Day	Time	Room
29.08.2022	Monday	14:00 - 17:15	B 317 Seminarraum (A5, 6 Bauteil B)
30.08.2022	Tuesday	9:15 - 17:15	B 317 Seminarraum (A5, 6 Bauteil B)
31.08.2022	Wednesday	9:15 - 13:15	B 317 Seminarraum (A5, 6 Bauteil B)
01.09.2022	Thursday	9:15 - 17:15	B 317 Seminarraum (A5, 6 Bauteil B)
02.09.2022	Friday	9:15 - 12:30	B 317 Seminarraum (A5, 6 Bauteil B)

Contents

- Introduction
- Set Theory
  - Sets, Binary Relations, Functions
- Analysis I
  - Equations, Differentiation
- Analysis II
  - Optimization, Integration
- Linear Algebra I
  - Linear Combinations, Vector Spaces, Matrices
- Linear Algebra II
  - Determinants, Gaussian Elimination
- Probability I
  - Combinatorics, Bayes' Rule
- Probability II
  - Distributions

Readings

Here are some recommended readings. You are not required to read all of those books prior to class.

- General
  - Moore/Siegel (2013) *An introductory mathematics course aimed at social scientists, provides good intuitions for basic concepts and applications. It has accompanying video lectures on Youtube.*
  - Gill (2006) *Another introduction to mathematical principles for incoming social science graduate students.*
  - Simon/Blume (1994) *A comprehensive treatment of mathematics for students of economics for both undergraduate and more advanced level.*
  - Sydsaeter/Hammond (2008) *Another standard mathematics textbook for economics undergraduates.*
- Calculus
  - Spivak (2006) *A classic standard textbook for a first class in Calculus for mathematics students at undergraduate level.*

- – Protter/Morrey (1991) *A typical theorem-proof book that covers introductory real analysis for mathematics students at undergraduate level. Short and to the point.*

- Linear Algebra

  - – Lay (2011) *A standard introduction for mathematics undergraduates.*

  - – Strang (2005) *Another standard introduction for mathematics undergraduates. Strang's MIT video lectures accompanying the textbook are available online for free.*

  - – Hefferon (2014) *A theorem-proof style introductory book for mathematics undergraduates with lots of examples and interesting applications. It is free[1].*

  - – Axler (2015) *A more rigorous but intuitive treatment of linear algebra for mathematics undergraduates.*

  - – The Matrix Cookbook[2] *An overview over some more advanced matrix calculus.*

- Probability Theory

  - – DeGroot/Schervish (2011) *A comprehensive standard treatment of probability and statistics for mathematics undergraduate students. Intuitive and (relatively) rigorous at the same time with lots of exercises.*

Additional Resources

Here are some recommended non-textbook extra materials for this course and future references on the topics covered.

Text resources:

- Math Prefresher for Political Scientists
  - – Math Part I: chapters 1 to 6

Video resources:

- Essence of calculus
- Essence of linear algebra
- Linear Algebra by Khan Academy

Learning Tools:

- Wolfram Alpha
  - – Wolfram Alpha, among other things, is an excellent tool for computing, ploting and undestanding limits, derivatives, and integrals and their applications.

References

Axler, S. (2015). *Linear Algebra Done Right* (3rd ed.). Undergraduate Texts in Mathematics. Springer.

DeGroot, M. H. and M. J. Schervish (2011). *Probability and Statistics* (4th ed.). London: Pearson.

Gill, J. (2006). *Essential Mathematics for Political and Social Research*. Cambridge University Press.

---

[1] https://hefferon.net/linearalgebra/
[2] http://www2.imm.dtu.dk/pubdb/views/edoc_download.php/3274/pdf/imm3274.pdf

Hefferon, J. (2014). *Linear Algebra*.

Lay, D. C. (2011). *Linear Algebra and Its Applications*. London: Pearson.

Moore, W. H. and D. A. Siegel (2013). *A Mathematics Course for Political and Social Research*. Princeton: Princeton University Press.

Protter, M. and C. Morrey (1991). *A First Course in Real Analysis* (2nd ed.). Undergraduate Texts in Mathematics. Springer.

Simon, C. P. and L. Blume (1994). *Mathematics for Economists*. New York: Norton and Company.

Spivak, M. (2006). *Calculus* (3rd ed.). Cambridge University Press.

Strang, G. (2005). *Linear Algebra and Its Applications* (4th ed.). Brooks Cole.

Sydsaeter, K. and P. Hammond (2008). *Essential Mathematics for Economic Analysis* (3rd ed.). Essex: Pearson.