

Syllabus

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1 Course Description

This course teaches the main statistical tools used to analyze spatial economic data. The first part of the course is about Economic Statistics: summarizing spatial economic data and empirical relationships via recently developed methods from spatial statistics. After that, we transition to Statistical Economics: economic models of spatial phenomena and tests of economic hypotheses. The teaching formats are lectures, readings, computational assignments, presentations, and a final paper. The class also imparts the use of the statistical software R, interactive programming via Shiny, and reproducible reporting via R Markdown.

Workload: 3 SWS, 10 ECTS (About 40 hours of seminar lectures and assignment-reviews, about 200 hours of self-study).

Grading: Final paper.

Prerequisites: Basic knowledge of statistics and econometrics (e.g., passed both “Statistik und Wahrscheinlichkeitsrechnung” and “Oekonometrie”). Taking my “Microeconometrics” first is also recommended but not required.

Class Size: < 15.

2 Assignments

At the end of the semester, you will write a paper and give a presentation on a replication-extension project. As the name suggests, you will replicate a paper and then extend a paper using the materials we cover in class. The paper and presentation determine your final grade. There will also be lab tutorials related to my weekly lecture.

Labs. You will work through small lab assignments in class after the lecture. These labs are computer applications related to the lecture or to your replication-extension project. You will work on your personal computer (before each lab, verify all R-packages are installed and working on your PC).

Homework. There are no problem sets, but you are to work on research tasks each week.

Presentation/Poster. You will summarize and present your progress on your final project (about 30 minutes of slides and a poster).

Final Paper. You will write an paper by the end of the semester of around 20 – 30 pages. More details will come, but you will write a clear and concise paper on a topic using the tools you have learned.

3 Outline

Our schedule will mirror that of a typical research project. We begin with Economic Statistics where we summarize and describe spatial economic data under minimal assumptions. We then proceed to Statistical Economics where we theoretically model data generating processes and formally test our hypotheses. I plan for the following timeline, but reserve the right to change it any point.

Week	Lecture & Lab	Research
1	Introduction to Course, Software, & Geometry	Read Rbooks 1-11
Economic Statistics		
2	Point Processes	Read Papers
3	Point Statistics	Choose Main Paper + 2 Backups
4	Random Fields	Write Literature Review
5	Bivariate Relationships	Reproduce Main Results
6	Spatial Regressions	Reproduce Main Results
7	Line/Polygon Data	Discuss Main Paper and Plans
8	Advanced Programming	<i>Proposal Due</i>
Statistical Economics		
9	Location Choices	Reproduce Main Results
10	Spatial Games	Reproduce Main Results
11		<i>Student Posters</i>
12	General Equilibrium	Extend Main Results
13		<i>Student Presentations</i>
14		<i>Student Papers Due</i>

4 Reference Material

Lectures will mostly be based on my notes. You can also refer to these textbooks, which are the basis of my lectures on the portion of the course on spatial statistics.

- E. Pebesma and R. Bivand (2022). *Spatial Data Science with applications in R*. <https://r-spatial.org/book/>
- A. Baddeley, E. Rubak, and R. Turner (2015). *Spatial Point Patterns: Methodology and Applications with R*. Chapman and Hall/CRC. <https://book.spatstat.org/>
- G. Arbia, G. Espa, and D. Giuliani (2021). *Spatial microeconometrics*. Routledge. <https://www.routledge.com/Spatial-Microeconometrics/Arbia-Espa-Giuliani/p/book/9781138833753>

I also refer you to this additional background material.

Textbooks with Statistical Theory Focus:

- * M. N. M. van Lieshout (2019). *Theory of Spatial Statistics: A Concise Introduction*. Chapman and Hall/CRC
- The Mathematics of GIS. Wolfgang Kainz. 2010.

- O. Schabenberger and C. A. Gotway (2005). *Statistical methods for spatial data analysis: Texts in statistical science*. Chapman and Hall/CRC
- N. Cressie (2015). *Statistics for spatial data*. revised. John Wiley & Sons
- M. M. Fischer and J. Wang (2011). *Spatial data analysis: models, methods and techniques*. Springer Science & Business Media
- H. Kelejian and G. Piras (2017). *Spatial Econometrics*. Elsevier Science. <https://books.google.de/books?id=5S8UDgAAQBAJ> includes R Code.
- K. Sobczyk and D. J. Kirkner (2001). *Stochastic modeling of microstructures*. Springer Science & Business Media
- J. P. Elhorst (2014). *Spatial econometrics from cross-sectional data to spatial panels*. Springer
- A Primer for Spatial Econometrics: With Applications in R. Giuseppe Arbia. 2014. *Ch 1-3*
- Spatial Econometrics: Methods and Applications. Giuseppe Arbia and Badi H. Baltagi. 2008.
- Introduction to Spatial Econometrics. James LeSage and Kelley R. Pace. 2009.
- Handbook of Spatial Statistics. Alan E. Gelfand, Peter Diggle, Peter Guttorp, and Montserrat Fuentes. 2010.
- A. Fotheringham, C. Brunson, and M. Charlton (2003). *Geographically Weighted Regression: The Analysis of Spatially Varying Relationships*. Wiley. <https://books.google.de/books?id=9DZgV1vXOuMC>
- D. T. Hristopulos (2020). *Random Fields for Spatial Data Modeling: A Primer for Scientists and Engineers*. Hristopulos, Dionisis. Springer
- P. J. Diggle (2013). *Statistical Analysis of Spatial and Spatio-Temporal Point Patterns*. 3rd ed. Taylor & Francis. 302 pp. <https://books.google.com/books?id=XR8bAAAAQBAJ>
- Spatial Statistics and Modeling. Carlo Gaetan and Xavier Guyon. 2010.
- Advanced Spatial Statistics. Daniel Griffith. 1988.
- Random Fields: Analysis and Synthesis. Revised and Expanded New Edition, 2010.
- Spatial Econometric Interaction Modelling. Roberto Patuelli, Giuseppe Arbia. 2016.

Textbooks and Notes with Statistical Programming Focus:

- * Spatial Data Science with R. Robert J. Hijmans. 2021. <https://rspatial.org/terra/index.html>.
- * Displaying Time Series, Spatial, and Space-Time Data with R. 2nd Edition. Oscar Perpinan Lamigueiro. 2018.
- Introduction to Spatial Data Programming with R. Michael Dorman. 2022. <http://132.72.155.230:3838/r/index.html>, <https://geobgu.xyz/r/>.
- Intro to GIS and Spatial Analysis. Manuel Gimond. 2022. <https://mgimond.github.io/Spatial/>.
- Spatial Modelling for Data Scientists. Francisco Rowe and Dani Arribas-Bel. 2022. <https://gdsl-ul.github.io/san/>.
- Applied Spatial Statistics and Econometrics: Data Analysis in R. Katarzyna Kopczewska. 2020.
- An Introduction to R for Spatial Analysis and Mapping. Chris Brunson and Lex Comber. 2019.
- Spatial Data Analysis: Models, Methods and Techniques. Fischer, Manfred M., Wang, Jinfeng. 2011. *Ch 4-5*.
- Analyzing Spatial Models of Choice and Judgment. By David A. Armstrong, Ryan Bakker, Royce Carroll, Christopher Hare, Keith T. Poole, Howard Rosenthal. 2021.
- R as GIS for Economists. Taro Mieno. 2022. <https://tmieno2.github.io/R-as-GIS-for-Economists/index.html>.

- Geocomputation with R. Robin Lovelace, Jakub Nowosad, Jannes Muenchow. 2021. <https://geocompr.robinlovelace.net/>, <https://bookdown.org/robinlovelace/geocompr/>.
- Spatial microsimulation with R. Lovelace, R., Dumont, M.. 2016. <https://spatial-microsim-book.robinlovelace.net/index.html>.
- Spatio-Temporal Statistics with R. 2019. Christopher K. Wikle, Andrew Zammit-Mangion, and Noel Cressie. <https://spacetimewithr.org/>.
- Intro to GIS and Spatial Analysis. Manuel Gimond. 2022. <https://mgimond.github.io/Spatial/index.html>.
- <https://jo-wilkin.github.io/GEOG0030/coursebook/>