Spatial methods for economists using Python

University of Bern

August 30 - September 3, 2021

Prof. Dr. Olivier Schöni

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1. General Information

Course Manager

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Time, Venue, Language, and Credits

Time: August 30- September 3, 2021

Venue: University of Bern, A222 UniS, Schanzeneckstrasse 1 (TBC), Bern

Language: English

Credits: 3 ECTS MASTER

Teaching Method

9 lectures and 3 group project sessions.

Teaching Material

Lecture notes, data, and code are available prior to the lecture and can be downloaded from a server of the University of Bern and/or Dropbox.

Course Objectives and Content

In the last decade, the use of spatial data in empirical analyses has spread to a variety of economic fields, including urban and real estate economics, development and environmental economics, labor and public economics, economic history, and trade. The aim of the course is to provide students and researchers with an effective and systematic workflow allowing them to extract and structure information provided by spatial data. To this end, the course will primarily focus on the automation of tasks involving spatial data using Python and ArcGIS. Among others, these tasks include importing different formats of spatial data, projecting spatial data to a common reference system, defining a spatial structure, selecting areas according to specific rules, merging data according to their spatial relationship, computing spatial statistics, and exporting the results. Additionally, the course will show how to integrate

these tasks into the workflow of standard statistical software, such as R and Stata. The programming part of the lecture is complemented with a discussion of papers published in leading economic journals that exploit spatial data in their econometric analyses.

Expected Learning Outcomes

1. Students can write a script in Python to extract relevant information from GIS data.
2. Students have a good understanding of how spatial data can be exploited in econometric analyses.
3. Students can integrate Python scripting into the code of standard statistical software.
4. Students can use ArcGIS to create maps and investigate spatial dynamics visually.

Evaluation

The grade will be determined by a group project in which 2-3 students have to replicate and present the spatial analysis carried out in an academic paper and/or to carry out a series of tasks proposed by the teacher. Each group will present its project to the class on the last day of the course.

2. Syllabus (Provisional)

Lectures

1. Introduction to spatial data

1.1. Motivation and role in empirical analysis

1.2. Goals of the course

1.3. Why Python and ArcGIS?

1.4. Types of spatial data, projections, where to obtain spatial data

1.5. Opening and working with ArcGIS

2. Introduction to Python and arcpy

2.1. Python IDEs and setting up a project

2.2. Structure of a python script

2.3. A crash course in Python

2.4. Basics of SQL for data selection

3. Vector data

3.1. Where to find help/ information

3.2. Arcpy tools for vector data

4. Project assignment and discussion of papers

4.1. Groups' definitions, assignment of projects

4.2. Introduction to using spatial data in econometrics

4.3. Discussion of papers using spatial data as dependent variable, variable of interest, and/or controls.

5. Raster data

5.1. Arcpy tools for raster data

5.2. Focus on elevation data

5.3. Conversion tools

6. Discussion of papers

6.1. Discussion on spatial data and endogeneity issues – Part 1

6.2. Using spatial data to derive instruments

7. Advanced Python programming and maps

7.1. Debugging

7.2. Coding tips and tricks, improving execution time

7.3. Writing your own functions

7.4. Creating maps

8. Discussion of papers

8.1. Discussion on spatial data and endogeneity issues – Part 2

8.2. Using spatial data to implement boundary discontinuity designs

8.3. Other topics: level of spatial aggregation and of clustering standard errors

9. Integrating Python into Stata and R

9.1. Importing and preparing spatial data in Stata and R

9.2. Running python scripts from Stata and R

9.3. Overview of packages for handling spatial data in Stata and R

10. Group project – Part 1

10.1. Questions and answers lecture on group projects

11. Group project – Part 2

11.1. Presentation of group projects by students

12. Group project – Part 3

12.1. Presentation of group projects by students

3. Schedule (Provisional – time allocation is indicative only)

Date (Day)	*Lecture/Seminar*	*Time*
30 August	**Lecture 1** (Introduction to ArcGIS)	09:30 – 11:00
	Break	
	Lecture 2 (Introduction to Python and arcpy)	10:15 – 11:45
	Lunch break	
	Lecture 3 (Vector data)	13:00 – 14:30
	Break	
	Lecture 4 (Project Assignment + Discussion of papers)	14:45 – 16:15
31 August	**Lecture 5** (Raster data)	09:30 – 11:00
	Break	
	Lecture 6 (Discussion of papers)	10:15 – 11:45
1 September	**Lecture 7** (Advanced Python programming and maps)	09:30 – 11:00
	Break	
	Lecture 8 (Discussion of papers)	10:15 – 11:45
2 September	**Lecture 9** (Python integration in Stata and R)	09:30 – 11:00
	Break	
	Lecture 10 (Group project – Q&A)	10:15 – 11:45
3 September	**Lecture 11** (Group project - Presentations)	09:30 – 11:00
	Break	
	Lecture 12 (Group project - Presentations)	10:15 – 11:45

4. Reading List (Provisional)

Text Books

The course does not build on a textbook. No existing textbook covers all the topics covered in this course. However, if you are looking for a general introduction to Python scripting for ArcGIS, I can recommend the following:

Silas T. and O'Beirne D., 2017, ArcPy and ArcGIS: Automating ArcGIS for Desktop and ArcGIS Online with Python, Packt Publishing.

Zandbergen, P. A., 2020, Python Scripting for ArcGIS Pro, Esri Press.

Zandbergen, P. A., 2020, Advanced Python Scripting for ArcGIS Pro, Esri Press.

Papers List by Lecture (Provisional)

Lecture 4	
Compulsory readings	Banzhaf, H. S., and Walsh, R. P. 2008. Do People Vote with Their Feet? An Empirical Test of Tiebout, *American Economic Review,* 98 (3): 843-63. Bernstein, A., Gustafson, M.T, Lewis, R. 2019. Disaster on the horizon: The price effect of sea level rise, *Journal of Financial Economics*, 134(2): 253-272. Burchfield, M., Overman, H.G., Puga, D., Turner, M.A. 2006. Causes of Sprawl: A Portrait from Space, *The Quarterly Journal of Economics*, 121(2): 587–633. Eichholtz, P., Nils K., and Quigley, J.M. 2010. Doing Well by Doing Good? Green Office Buildings. *The American Economic Review*, 100(5): 2492-509 Kurlat, P., Stroebel, J. 2015. Testing for Information Asymmetries in Real Estate Markets. *The Review of Financial Studies*, 28(8): 2429–2461.
Lecture 6	
Compulsory readings	Bai, Y. and Jia, R. 2016. Elite Recruitment and Political Stability: The Impact of the Abolition of China's Civil Service Exam, *Econometrica*, 84: 677–733. Bakker, J.D., Maurery, S., Pischkez, J-S., and Rauch, F. 2021. Of Mice and Merchants: Connectedness and the Location of Economic Activity in the Iron Age. *Review of Economics and Statistics* (forthcoming). Volume Title: Agglomeration Economics, Volume Author/Editor: Edward L. Glaeser, (editor). Volume Publisher: The University of Chicago Press, Publication Date: February 2010. Chapter Title: Estimating Agglomeration Economies with History, Geology, and Worker Effects. Chapter Author: Pierre-Philippe C., Duranton, G., Gobillon, L., Roux, S. Michaels, G. 2008. The Effect of Trade on the Demand for Skill: Evidence from the Interstate Highway System, *The Review of Economics and Statistics*, 90(4): 683-701. Saiz, A. 2010, The Geographic Determinants of Hosing Supply, *Quarterly Journal of Economics,* 125: 1253–1296.

Lecture 8	
Compulsory readings	Basten, C., von Ehrlich, M. and Lassmann, A. 2017. Income Taxes, Sorting and the Costs of Housing: Evidence from Municipal Boundaries in Switzerland. *Economic Journal*, 127: 653-687. Briant, A., Combes, P.-P. , Lafourcade, M. 2010. Dots to boxes: Do the size and shape of spatial units jeopardize economic geography estimations? *Journal of Urban Economics*, 67(3): 287-302. Lalive, R. 2008. How do extended benefits affect unemployment duration? A regression discontinuity approach, *Journal of Econometrics*, 142(2): 785-806. Michaels, G., Dzhamilya, N., Rauch, F., Regan, T., Baruah, N., Dahlstrand, A. Planning Ahead for Better Neighborhoods: Long Run Evidence from Tanzania, *Journal of Political Economy* (forthcoming).