Georg-August-Universität Göttingen Public Law Foundation

Faculty of Business and Economics
Chair of Development Economics
Prof. Dr. Andreas Fuchs

Syllabus

Geospatial Analysis for Development Economics

(Räumliche Analyse in der Entwicklungsökonomik)

Summer semester 2020

(as of March 27, 2020)

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1. General Information

1.1 Course content

This course for advanced Master and PhD students provides an overview of how space is used in empirical economics with a particular focus on development economics. It introduces the basic tools employed in geospatial research. We will cover geographic projections, geospatial data types, vector and raster data processing, and a selection of more advanced topics. After obtaining the toolkit, we will then learn how these techniques are applied in development economics and beyond, by replicating a selection of influential papers.

1.2 Course goals

The goal of the course is twofold (i) to expose students to a large and relatively new literature in economics that uses geospatial data in innovative ways, and (ii) to provide students with the

methodological skills needed to critically assess these papers. The participants will learn to "think spatially" and come up with their own original research questions utilizing spatial methods. To train this skill set, students will complete a term project and solve in-class assignments throughout the course.

After completing this course, students should be able to conduct their own spatial analysis for research or public policy jobs. They will be well positioned to continue with additional classes in remote sensing and/or statistical learning with geographic data.

1.3 Prerequisites

Students should be familiar with mathematical statistics, basic econometrics and development economics. Some experience with R will be extremely helpful to not slow us down. Students without such experience are encouraged to take the **preparatory *R* course offered beforehand**, work through parts of the recommended R book, and/or train with Datacamp's excellent online courses.

1.4 Credit points

6 ECTS-LP

1.5 Registration

Please register via FlexNow until **Thursday, April 30, 2020**. The attendance at the introductory meeting is compulsory for registration. The number of participants is restricted to 20. If not all places have been filled by the deadline, we will re-open registration at the first seminar meeting (Session 1).

2. Course overview

2.1 Description of the teaching and learning methods

The seminar is a blocked class between June 18 to June 24. It is complemented with a non-compulsory accompanying *R* course on June 9 and June 16. This additional course offer is strongly recommended for students without significant previous experience with *R*. Students will have the possibility to attend an open Q&A sessions to discuss problems and share experiences with their ongoing term project on **Monday, August 10, 2020**. **The course language is English.**

2.2 Meetings

Due to the current situation (coronavirus), the course may be offered online. Please register for the course on Stud.IP so that you receive all information in this regard.

Introductory Meeting [Apr 20, 2020, 18:00-19:00]

Accompanying R-Course [Jun 09 & Jun 11, 2020, 16:00 - 20:00]

- Contents
    - Introduction to R
    - Understanding data formats, objects and functions in R
    - Introduction to the "tidyverse" package

- Lab activities
    - First steps in R
    - Piping and tidyverse

Session 1: Introduction to geospatial analysis [Jun 15, 2020, 17:00 – 20:30]

- Contents
    - Survey of geospatial research in economics
    - What is geospatial analysis? What is remote sensing?
    - Survey of geospatial data types
    - Datums, projections and distances

- Key readings
    - Donaldson, D. and A. Storeygard. 2016. The View from Above: Applications of Satellite Data in Economics. *Journal of Economic Perspectives*, 30(4), 171–198.
    - Michalopoulos, S. and E. Papaioannou. 2018. Spatial Patterns of Development: A Meso Approach. *Annual Review of Economics*, 10(1), 383–410.
    - Grolemund and Wickham 2017, Chapters 9–21.
    - Lovelace et al. 2018, Chapter 1.

- Lab activities
    - First steps in R with sf

Session 2: Vector data types [Jun 16, 2020, 18:00 – 20:30]

- Contents
    - Projections and spatial references
    - Points, lines, polygons, and grids

- - Reading and writing vector data
  - Making maps of vector data
  - Finding and accessing online vector data
- Key readings
  - Lovelace et al. 2018, Chapter 2.1, 2.3, 2.4
- Lab activities
  - Calculating road densities and mapping African infrastructure
  - Projections, areas and distances

Session 3: Manipulating vector data [Jun 17 & Jun 18, 2020, 18:00 - 20:30]

- Contents
  - Making points, lines and polygons
  - Topology and topological relations
  - Geometric operations and buffers
  - Spatial joins and aggregation
- Key readings
  - Lovelace et al. 2018, Chapter 3.2, 4.2, 5
- Lab activities
  - Dealing with invalid polygons
  - Road densities at the cell level

Session 4: Raster data [Jun 19, 2020, 18.00 -20.30]

- Contents
  - Raster data types and resolutions
  - Reading and writing raster data
  - Cropping, masking and resampling
  - Extracting, aggregating and dis-aggregating
  - Finding and accessing online raster data
- Key readings
  - Lovelace et al. 2018, Chapter 3.3, 4.3, 5.3, 5.4
- Lab activities
  - Population and light densities in Kenya
  - Classifying urban areas and finding city footprints

Session 5: Geocoding [Jun 22, 2020, 18:00 - 20:30]

- Contents
  - Geocoding non-spatial data
  - Combining spatial and non-spatial data
  - (if time allows) Georeferencing offline maps
- Key readings

- AidData Research and Evaluation Unit. (2017). Geocoding Methodology, Version 2.0.1. Williamsburg, VA: AidData at William & Mary.
- BenYishay, A., Rotberg, R., Wells, J., Lv, Z., Goodman, S., Kovacevic, L., Runfola, D. 2017. Geocoding Afrobarometer Rounds 1-6: Methodology & Data Quality. Williamsburg, VA: AidData at William & Mary.
- Lab activities
  - Geocoding cities and other points on a map

Session 6: Replication – Night lights [Jun 23 & Jun 24, 2020, 18:00 - 20:30]
- Contents
  - Measuring welfare in developing countries
  - Advantages and pitfalls of night lights
- Key readings
  - (replication) Alesina, A., S. Michalopoulos, and E. Papaioannou. 2016. Ethnic Inequality. *Journal of Political Economy*, 124(2), 428–488.
  - (background) Henderson, J. V., A. Storeygard, and D. N. Weil. 2012. Measuring Economic Growth from Outer Space. *American Economic Review*, 102(2), 994–1028.
- Lab activities
  - Calculating ethnic and spatial inequality in Afghanistan
  - Creating Voronoi (Thiessen) polygons and "virtual" homelands

Session 7: Replication – Slave trade [Jun 25 & Jun 26, 2020, 18.00 - 20.30]
- Contents
  - Slave trade as an obstacle to the formation of larger ethnic groups and trust
  - Distances as an instrument and controls
- Key readings
  - (replication) Nunn, N. 2008. The Long-Term Effects of Africa's Slave Trades. *Quarterly Journal of Economics*, 123(1), 139–176.
  - (background) Nunn, N., and L. Wantchekon. 2011. The Slave Trade and the Origins of Mistrust in Africa. *American Economic Review*, 101(7), 3221–3252.
- Lab activities
  - Calculating overland distance to slave trade centers
  - Calculating sailing distances to slave trade centers

Q&A Exam [Jun 29, 2020, 18.00 - 20.00]

With Richard Bluhm

Q&A Term Paper [Aug 10, 2020, 12.00 - 16.00]

With Sebastian Schmidt

2.3 Examination and grading of the module

This course will be graded according to the German numeric system. Each grade has two components:

- Short take-home exam (50%), handout: July 4, 2020, 10:00; due: July 6, 2020, 00:01
- Replication project, max. 10 pages (50%), due September 7, 2020

2.4 Course materials

- You find the required and recommended readings on each topic listed above (see 2.2).

- We are not really following any textbook but this comes closest to explaining a lot of what is covered in the course:

  Lovelace, R., Nowosad, J., and J. Muenchow. 2019. Geocomputation with *R*. CRC Press. Available online, for free!

- If you are struggling with R or are new to the tidyverse, then I recommend

  Grolemund, G. and H. Wickham. 2017. *R* for Data Science. O'Reilly. Available online, for free!

- All lecture slides and exercise questions will be published on Stud.IP.

Copyright notice: Many sources are not yet properly attributed on the lecture slides, so please to not share these materials widely. I owe a great debt to those who have developed GIS classes for economics audiences before: Masayuki Kudamatsu's IIES course for ArcGIS has been an inspiration to many classes including this one, but I have also used materials from a class Stelios Michalopoulos gave in UWarwick many years ago and a class previously taught Paul Raschky at USt. Gallen.