



COURSE SYLLABUS
The Theory and Practice of Spatial Econometrics

AGEC 63100 – Spring 2017

Instructor

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Lectures: Monday, 1:30 – 4:20 PM, Recitation Building, Room 226

Consultation: Immediately after class or as needed by appointment

Course description

It is almost impossible to not notice the upsurge in the advancement of econometric theory for spatial cross-section models, the availability of easy-to-use software for spatial data analysis, and the use of spatial econometric techniques in applied research in many areas of scientific research, including in economics. The renewed interest in space among economists is driven by theoretical advancements related to the analysis and incorporation of interdependent behavior of economic agents (social networking, spatial sorting, strategic decision-making), as well as by New Economic Geography theories and modern urban economics with its emphasis on location and agglomeration externalities and spatial knowledge spillovers. In many other areas, the recognition that social and natural phenomena (e.g., deforestation, transportation, climate change, food security, criminal behavior, spread of disease, and wars and revolutions) are inherently spatial has contributed much to the increased awareness for the use of appropriate spatial analysis techniques. Arguably, the increased availability of spatially referenced data through the Internet and access to Geographical Information Systems (GIS) play a role as well. This course deals with the use of spatial data analysis techniques, in particular spatial econometric modeling or spatial regression modeling.

Spatially referenced data are special in the sense that the spatial arrangement of the observations provides important information that should not be ignored. The areas of spatial statistics and spatial econometrics are concerned with developing appropriate methods for the analysis of spatial data. This course focuses on the theoretical foundations of spatial data analysis and on how they can be effectively applied, with a particular emphasis on the analysis of spatial heterogeneity and spatial autocorrelation in the context of regression models. The course will cover the use of exploratory

spatial data analysis techniques, but will predominantly be focused on spatial regression models and appropriately defined estimators for spatial data. Extensions of the standard approaches for continuous data will deal with spatial effects in limited dependent variable (or discrete choice) models, and “panel” models for space-time data or flow (origin–destination) data.

The literature that is discussed covers theoretical texts on the foundation of spatial statistics and spatial econometrics as well as a series of examples from applied research. The latter can include models of diverse topics, such as economic growth, population-employment dynamics, land use, hedonic pricing models, location choice for waste management and other hazardous facilities, obesity and access to health care, the environmental Kuznets curve, and deforestation.

An important second goal of the course is to provide an interactive demonstration of spatial software for exploratory and explanatory (econometric) analyses. To this effect, the lectures include applications of several software packages. The available computational tools range from packages with elaborate graphical user interfaces (GUIs), such as OpenGeoDa, GeoDaSpace and Stata, to packages that require programming and/or the use of pre-developed “functions” such as the spatial econometric toolbox in Matlab, and user-developed routines in the programming language R, specifically the packages or libraries designed by Roger Bivand, Daniel McMillen, and Gianfranco Piras. In class and for writing papers R and its constituent packages as well as OpenGeoDa and GeoDaSpace are preferred and they will be actively used.

The overarching goal of the course is that the materials covered will allow you to carry out a complete and sound spatial data analysis “project” after completion of the course, for instance in the context of your own thesis or dissertation. During the course you are expected to develop and execute such a project, resulting in a term paper, which is the major assignment of the course. You can either use your own data for such a project or, alternatively, data sets accessible over the Internet, or one of several datasets utilized as sample data for demonstration purposes.

Prerequisites

A good working knowledge of basic statistics and regression techniques is needed. Prior experience with GIS is helpful, but not required.

Texts

There are several textbook-like monographs covering parts of the contents of this course. For instance:

- Anselin, L., *Spatial Econometrics: Methods and Models*, Boston: Kluwer Academic, 1988.
- Cliff, A.D. and J.K. Ord, *Spatial Processes: Models and Applications*, London: Pion, 1981.
- Cressie, N., *Statistics for Spatial Data*, New York: Wiley, 1993 (rev. ed.).
- Upton, G. and B. Fingleton, *Spatial Data Analysis by Example*, New York: Wiley, 1985.

Most of these books are rather old, and considerable progress has been made in spatial statistics but especially in spatial econometrics since these books were published. A few more up-to-date monographs are:

- Elhorst, J.P., *Spatial Econometrics: From Cross-Sectional Data to Spatial Panels*, Heidelberg, Springer, 2014.

- Fischer, M.M. and J. Wang, *Spatial Data Analysis: Models, Methods and Techniques*, Heidelberg: Springer, 2011.
- Fotheringham, A.S., C. Brunson and M. Charlton, *Quantitative Geography: Perspectives on Spatial Data Analysis*, London: Sage, 2000.
- Haining, R., *Spatial Data Analysis: Theory and Practice*, Cambridge: Cambridge University Press, 2003.
- LeSage, J.P and R.K. Pace, *Introduction to Spatial Econometrics*, Boca Raton: CRC Press/Taylor and Francis Group, 2009.
- Schabenberger, O. and C.A. Gotway, *Statistical Methods for Spatial Data Analysis*, Boca Raton: Chapman & Hall/CRC Press, 2005.

Many of the above books are available from the Purdue library. The course presentations, the required readings and the workbook provide references to several more recent papers, some of which are introductory and others are more advanced.

The required readings for this course are two very recently published books, which provide an excellent overview of the state-of-the-art of spatial econometrics:

- Anselin, L. and S.J. Rey, *Modern Spatial Econometrics in Practice: A Guide to GeoDa, GeoDaSpace and PySAL*, Chicago: GeoDa Press, 2014.
- Arbia, G., *A Primer for Spatial Econometrics: With Applications in R*, New York: Palgrave Macmillan, 2014.

The first book comes in a paperback and a Kindle version, priced around \$55 and \$10, respectively. The second book is available as paperback or Kindle for approximately \$35, and in hardcover for approximately \$95. Another, very useful and instructive book about spatial data analysis and mapping in R, which is not part of the required reading, is:

- Brunson C. and L. Comber, *An Introduction to R for Spatial Analysis & Mapping*, Los Angeles: SAGE, 2015.

Policies

1. Grading is based on homework assignments, class presentations, and the term paper. The homework and class presentations are worth 20 percent each. The term paper, due at the last day of classes, accounts for 60 percent. Details are presented during the first lecture.
2. Class attendance and active participation are required.
3. Incomplete grades are not given unless extremely extenuating circumstances warrant. Late assignments will be graded by deducting points from the lowest score among those earned by students who turned their assignments in on time.

Course outline

The course covers a 16-week semester, with one class canceled for Martin Luther King Jr. Day and one for Spring Break, which leaves 14 class meetings. The program outline is as follows:

1. Intro to Econometric Modeling in Space (1)
2. Spatial Regression Models (2-3)

3. Estimators for Spatial Regression Models (4–5)
4. Specification Searches and Statistical Testing (6–7)
5. Spatial Heterogeneity (8–9)
6. Spatial Discrete Choice Models (10–11)
7. Spatial Panel Models and Models for Flow Data (12–13)
8. Spatial Econometrics as a Methodology (14)

The content can be adjusted on the basis of revealed student preferences. The class consists of lectures introducing a topic, in combination with lab sessions demonstrating operational and computational aspects using the software packages described above. All software packages are freely downloadable from the Internet. You are encouraged to bring your laptop to the lab sessions in order to develop hands-on practice in spatial data analysis and spatial regression.