



Course Syllabus
ARE/ECON 729: Spatial Econometrics
Department of Agricultural and Natural Resource Economics and Economics
Spring 2015

Instructor Information

Instructor: Donald J. Lacombe

Office Location: Agricultural Sciences Building, Room 2042
Regional Research Institute, Room 509 (5th Floor)
Chestnut Ridge Research Building

Office Hours: M and W 10:00 to 11:00 am (Ag Econ Office) or by appointment

Phone: (304) 293-8543

Email: donald.lacombe@mail.wvu.edu

Web Page: <http://community.wvu.edu/~djl041/>

Course Identification

Course Number: ARE 729 CRN 15337 (Ag Econ) ECON 729 CRN 15349 (Econ)

Course Name: Spatial Econometrics

Course Location: 2013 Agricultural Sciences Building (2nd Floor Computer Lab)
Evansdale Campus

Class Times: Monday and Wednesday from 11:00 a.m. to 12:15 p.m.

Course Description

This course is a lecture-based introduction to the methodology and application of spatial econometric models at the graduate level. We will examine such topics as model specification and model choice, specification testing in a spatial econometric framework, as well as a comparison of sampling theoretic and Bayesian variants of standard spatial econometric models. We will also gain experience using MATLAB as a platform for performing spatial econometric statistical analyses. This course is also listed as ARE 729 so that completion of this course excludes taking ARE 729 for credit.

Method of Instruction

The course will consist of lectures as well as computer laboratory exercises where we will examine how to utilize the Econometrics Toolbox and other programs in the MATLAB computer language.

Expected Learning Outcomes

- Students will be able to explain when and why to use spatial econometrics and demonstrate how to apply spatial econometric methods.
- Students will demonstrate an ability to estimate and interpret spatial econometric models from both a maximum likelihood perspective as well as from the Bayesian perspective.
- Students will be able to use MATLAB and Spatial Econometric Toolbox effectively.

Course Resources

Required Course Text

- Introduction to Spatial Econometrics by James P. LeSage and R. Kelley Pace. 1st Edition Chapman and Hall/CRC Press. ISBN-13: 978-1420064247.

Software

- **MATLAB Student Edition**

http://www.mathworks.com/academia/student_version/

- **Spatial Econometric Toolbox**

<http://www.spatial-econometrics.com/>

Web Resources

- **The course website**

<http://community.wvu.edu/~djl041/>

The course website will contain items such as homework assignments and other classroom materials and is designed to be the “one stop shop” for the course.

- Additionally, there will be some external links to various spatial econometric resources that are available online.

Course Requirements

- **Homework**

A major component of this course will consist of homework assignments in which students will use MATLAB in conjunction with the Spatial Econometrics Toolbox to perform various spatial econometric analyses.

- **Research Paper**

A second component of a student's final grade will consist of a research paper that utilizes spatial econometric techniques.

Grade Determination

Final grades in this course will be determined by a student's performance on the homework assignments and the final paper.

- **Homework (70% of course grade)**

The home work assignments will comprise 70% of a student's final course grade. Homework assignments will be graded on a pass/fail system with the assignments being graded for correctness and completeness. Details regarding the homework assignments, such as due dates and other items, will be outlined in class as well as through email communication with students.

- **Research Paper (30% of course grade)**

The second component of a student's final course grade will consist of a research paper on a topic of the student's own choosing, which will comprise 30% of a student's final course grade. Students will be responsible for choosing an appropriate topic and performing the appropriate statistical analyses as well as presenting the results in standard academic paper format. See attachment to this syllabus for paper guidelines.

The due dates associated with the paper project are as follows:

- **Wednesday, February 25, 2015**

Each student will be required to meet with me by this due date to discuss their paper topic and get my prior approval.

- **Wednesday, April 29, 2015**

The final version of the research paper will be due on this date.

The grading scale that will be used in the course is as follows

Percentage of Final Points	Course Grade
93% - 100%	A
90% - 92%	A-
87% - 89%	B+
83% - 86%	B
80% - 82%	B-
77% - 79%	C+
73% - 76%	C
70% - 72%	C-
67% - 69%	D+
63% - 66%	D
60% - 62%	D-
0% - 59%	F

Topic Outline

Listed below are some of the topics that we will cover throughout the semester. ***Note that this schedule is tentative and is subject to change.***

- **Topic 1: Introduction to Spatial Econometrics (Week 1)**
We will start out by examining what spatial autocorrelation is and how spatial econometric models differ from the standard ordinary least squares (OLS) model.
- **Topic 2: Spatial Weight Matrices (Week 2)**
In this topic, we will examine spatial weight matrices and how they are incorporated into spatial econometric analyses. Various methods for determining spatial weight matrices will be covered from a theoretical and practical standpoint.
- **Topic 3: Spatial Econometric Models (Weeks 3 & 4)**
A typology of spatial econometric models will be developed in this part of the course, from the basic spatial autoregressive (SAR) and spatial error model (SEM), to more exotic variants such as the two W spatial autoregressive model. We will examine the mathematical details of these models as well as how to estimate these models.
- **Topic 4: Maximum Likelihood Estimation of Spatial Econometric Models (Weeks 5 & 6)**
We will examine in this topic the estimation of spatial econometric models using maximum likelihood. Particular attention will be paid to practical implementation via

the Spatial Econometrics Toolbox. We will also discuss some of the computational challenges regarding estimation via maximum likelihood.

- **Topic 5: Interpreting Spatial Econometric Models (Week 7)**

The interpretation of spatial econometric models will be the focus of this part of the course. We will pay particular attention the new effects estimates as developed by LeSage and Pace.

- **Topic 6: Model Comparison and Testing (Week 8)**

The use of spatial econometric methods requires that we determine which model is most appropriate in any given modeling situation. In this topic, we will examine several Lagrange Multiplier tests designed to ascertain the appropriate model.

- **Topic 7: Basics of Bayesian Statistics (Weeks 9 & 10)**

Before we embark on our study of the Bayesian variants of spatial econometric models, we first need to know some basics which will be covered in this topic.

- **Topic 8: Gibbs Sampling and the Metropolis-Hastings Algorithm (Weeks 11)**

Given that the posterior distribution of the parameters in some Bayesian models is not analytically tractable, we need to find alternatives for making inferences. The basics of the Gibbs Sampler and the Metropolis-Hastings Algorithm will be presented in this topic.

- **Topic 9: Bayesian Variants of Spatial Econometric Models (Week 12 & 13)**

Given our previous study of maximum likelihood estimation of the standard spatial econometric models, we now turn attention to the Bayesian variants of these models. We will derive all of the mathematical details and implement the algorithms using the Spatial Econometrics Toolbox.

- **Topic 10: Bayesian Model Comparison (Week 14)**

In this topic, we will study model comparison in the Bayesian paradigm. Algorithms for producing the relevant quantities used in model comparison will be studied as well as their practical implementation.

- **Topic 11: Spatial Probit (Week 15)**

The spatial probit model presents additional computational difficulties that are routinely handled in the Bayesian context. We will study the spatial probit from a theoretical perspective and also learn how to estimate these models using the Spatial Econometrics Toolbox.

Please note that we may cover additional topics in the course if time permits.

Reading List

The following references are provided to enhance each student's understanding of the various topics. Students should read the required readings prior to each topic being discussed with the additional readings provided for completeness. Most of these readings are available online and links to the available online articles will be provided in each section below.

Please note that the required readings are in bold type.

- **Topic 1: Introduction to Spatial Econometrics**

Anselin, Luc. "Spatial Econometrics", p. 1-4.

http://www.csiss.org/learning_resources/content/papers/baltchap.pdf

LeSage, James P. "Regression Analysis of Spatial Data" *Journal of Regional Analysis and Policy*, vol. 27, no. 2, 1997, pp. 83-94.

<http://www.jrap-journal.org/pastvolumes/1990/v27/27-2-7.pdf>

Dubin, Robin. "Spatial Autocorrelation: A Primer" *Journal of Housing Economics*, vol. 7, no. 4, December 1998, pp. 304-327.

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6WJR-45J5C0V-2&_user=768492&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&_view=c&_auct=C000042518&_version=1&_urlVersion=0&_userid=768492&_md5=ab3985519a0cf772236a65cb29c09bc5

Anselin, Luc. "Spatial Econometrics: Methods and Models" Kluwer, 1988. Chapter 2.

- **Topic 2: Spatial Weight Matrices**

Anselin, Luc. "Spatial Econometrics", p. 5-6.

http://www.csiss.org/learning_resources/content/papers/baltchap.pdf

LeSage and Pace, "Introduction to Spatial Econometrics", pp. 118-120.

Anselin, Luc. "Spatial Econometrics: Methods and Models" Kluwer, 1988. Chapter 3.

- **Topic 3: Spatial Econometric Models**

LeSage and Pace, "Introduction to Spatial Econometrics", § 2.6.

LeGallo, Julie. "Cross-Section Spatial Regression Models" available at the following URL:

http://link.springer.com/referenceworkentry/10.1007/978-3-642-23430-9_85

LeSage, James P. "What Regional Scientists Need to Know About Spatial Econometrics" available at the following URL:

<http://journal.srsa.org/ojs/index.php/RRS/article/view/44.1.2>

Bramouille, Y., Habiba Djebbari, and Bernard Fortin. "Identification of Peer Effects Through Social Networks", *Journal of Econometrics*, vol. 150, no. 1, May 2009, pp. 41-55.

<http://www.sciencedirect.com/science/article/pii/S0304407609000335>

Anselin, Luc. "Spatial Econometrics: Methods and Models" Kluwer, 1988. Chapter 4.

Kalenkoski, Charlene and Donald J. Lacombe. "Effects of Minimum Wages on Youth Employment: the Importance of Accounting for Spatial Correlation" *Journal of Labor Research*, vol. 29, no. 4, December 2008, pp. 303-317.

<http://www.springerlink.com/content/g151848557476877/>

Lacombe, Donald J. and Timothy M. Shaughnessy. "Accounting for Spatial Error Correlation in the 2004 Presidential Popular Vote" *Public Finance Review*, vol. 35, no. 4, July 2007, pp. 480-499.

<http://pfr.sagepub.com/cgi/content/abstract/35/4/480>

LeSage, James P. and R. Kelley Pace. "Pitfalls in Higher Order Model Extensions of Basic Spatial Regression Methodology" available at the following URL:

<http://journal.srsa.org/ojs/index.php/RRS/article/view/39>

- **Topic 4: Maximum Likelihood Estimation of Spatial Econometric Models**

LeSage and Pace, "Introduction to Spatial Econometrics", Chapter 3.

Pace, R. Kelley. "Maximum Likelihood Estimation" available at the following URL:

http://link.springer.com/referenceworkentry/10.1007/978-3-642-23430-9_88

Ord, Keith. "Estimation Methods for Models of Spatial Interaction" *Journal of the American Statistical Association*, vol. 70, no. 349, March 1975, pp. 120-126.

<http://www.jstor.org/stable/2285387>

Doreian, Patrick. "Estimating Linear Models with Spatially Distributed Data", *Sociological Methodology*, vol. 12, 1981, pp. 359-388.

<http://www.jstor.org/stable/270747>

Anselin, Luc. "Spatial Econometrics: Methods and Models" Kluwer, 1988. Chapter 6.

- **Topic 5: Interpreting Spatial Econometric Models**

LeSage and Pace, "Introduction to Spatial Econometrics", pp. 16-19.

LeSage and Pace, "Introduction to Spatial Econometrics", pp. 33-43.

Dustin K. Kirby, James P. LeSage. "Changes in commuting to work times over the 1990 to 2000 period" *Regional Science and Urban Economics*, vol. 39, no. 4, July 2009, Pages 460-471.

<http://www.sciencedirect.com/science/article/B6V89-4VKDMPC-1/2/a7de009b0c1ca461f6fb1d4f6e496f03>

Dominguez, Matthew and James P. LeSage. "The Importance of Modeling Spatial Spillovers in Public Choice Analysis", *Public Choice*, online.

<http://www.springerlink.com/content/97lt3463682n5630/>

Elhorst, Paul J. "Applied Spatial Econometrics: Raising the Bar", *Spatial Economic Analysis*, vol. 5, no. 1, February, 2010, pp. 9-28.

<http://www.informaworld.com/smpp/title~db=all~content=g919553745>

LeSage, James P. and R. Kelley Pace. "The Biggest Myth in Spatial Econometrics" available on the SSRN website at the following URL:

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1725503

LeSage, James P. and R. Kelley Pace "Interpreting Spatial Econometric Models" available at the following URL:

http://link.springer.com/referenceworkentry/10.1007/978-3-642-23430-9_91

- **Topic 6: Model Comparison and Testing**

LeSage and Pace, "Introduction to Spatial Econometrics", pp. 155-168.

Luc Anselin, Anil K. Bera, Raymond Florax, Mann J. Yoon. "Simple diagnostic tests for spatial dependence" *Regional Science and Urban Economics*, Volume 26, Issue 1, February 1996, Pages 77-104.

<http://www.sciencedirect.com/science/article/B6V89-3VW1DKR-4/2/723d2026d38b9758201c61c4d74158d8>

Raymond J. G. M. Florax, Hendrik Folmer, Sergio J. Rey. "Specification searches in spatial econometrics: the relevance of Hendry's methodology" *Regional Science and Urban Economics*, Volume 33, Issue 5, September 2003, Pages 557-579.

<http://www.sciencedirect.com/science/article/B6V89-48B5PTG-3/2/5e8eb5e2e7ccc07eba6a344a86716cce>

- **Topic 7: Basics of Bayesian Statistics**

Lynch, Scott M. Introduction to Applied Bayesian Statistics and Estimation for Social Scientists. New York: Springer, 2006. Chapter 3.

<http://link.springer.com/book/10.1007/978-0-387-71265-9/page/1>

(Note: The above URL points to the Springer Link page where the entire book can be downloaded).

Bolstad, William M. Introduction to Bayesian Statistics. Hoboken, N.J.: Wiley, 2004. Chapter 4.

- **Topic 8: Gibbs Sampling and the Metropolis-Hastings Algorithm**

Lynch, Scott M. Introduction to Applied Bayesian Statistics and Estimation for Social Scientists. New York: Springer, 2006. Chapter 4: Gibbs Sampling.

<http://www.princeton.edu/~slynch/bayesbook.pdf>

Lynch, Scott M. Introduction to Applied Bayesian Statistics and Estimation for Social Scientists. New York: Springer, 2006. Chapter 5: Metropolis-Hastings Sampling.

<http://www.princeton.edu/~slynch/bayesbook.pdf>

Casella, George and Edward I. George. "Explaining the Gibbs Sampler" *The American Statistician*, vol. 46, no. 3, August 1992, pp. 167-174.

<http://www.jstor.org/stable/2685208>

Chib, Siddhartha and Edward Greenberg. "Understanding the Metropolis-Hastings Algorithm" *The American Statistician*, vol. 49, no. 4, November 1995, pp. 327-335.

<http://www.jstor.org/stable/2684568>

- **Topic 9: Bayesian Variants of Spatial Econometric Models**

LeSage and Pace, "Introduction to Spatial Econometrics", Chapter 5.

Lacombe, Donald J. "An Introduction to Bayesian Inference in Spatial Econometrics" (July 24, 2008).

<http://ssrn.com/abstract=1244261>

Mills, Jeffrey and Olivier Parent. "Bayesian MCMC Estimation" available at the following URL:

http://link.springer.com/referenceworkentry/10.1007/978-3-642-23430-9_89

LeSage, James P. "Bayesian Estimation of Spatial Autoregressive Models" *International Regional Science Review*, vol. 20, no. 1-2, 1997, pp. 113-129.

<http://irx.sagepub.com/content/20/1-2/113.short>

- **Topic 10: Bayesian Model Comparison**

LeSage and Pace, "Introduction to Spatial Econometrics", Chapter 5, pp. 168-184.

Hepple L W, 2004, "Bayesian model choice in spatial econometrics", in *Spatial and Spatiotemporal Econometrics (Advances in Econometrics, Volume 18)* Eds J P Lesage, R K Pace (Elsevier, Amsterdam) pp 101 – 126.

<http://web.cenet.org.cn/upfile/103649.pdf>

- **Topic 11: Spatial Probit**

LeSage and Pace, "Introduction to Spatial Econometrics", Chapter 10, pp. 279-297.

Franzese, Robert J. and Hays, Jude C. "The Spatial Probit Model of Interdependent Binary Outcomes: Estimation, Interpretation, and Presentation" (March 31, 2008).

<http://ssrn.com/abstract=1116393>

Wang, Cara. "Limited and Censored Dependent Variable Models" available at the following URL:

http://link.springer.com/referenceworkentry/10.1007/978-3-642-23430-9_92

Holloway, Garth J., Bhavani Shankar, and Sanzidur Rahman. "Bayesian spatial Probit Estimation: A Primer and an Application to HYV Rice Adoption" *Agricultural Economics*, vol. 27, no. 3, November 2002, pp. 383-402.

<http://www.sciencedirect.com/science/article/pii/S0169515002000701>

This article is part of a special issue devoted to spatial econometrics and agriculture.

Policies

- **WVU Social Justice Statement**

West Virginia University is committed to social justice. I concur with that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran's status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

- **Students with Disabilities**

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services (293-6700).

- **Academic Integrity**

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at <http://www.arc.wvu.edu/rightsc.html>. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter.

- **Attendance Policy**

Although I will not take attendance formally, I encourage all students to attend all classes regularly in order to get the most out of the class and material.

- **Make-up Policy**

There are no make-ups allowed on homework assignments. Students who are having difficulties with the final paper due to data or other issues can discuss the matter with the instructor and an extension may be granted in exceptional circumstances.

ARE/ECON 729 Research Paper Guidelines

As stated in the syllabus, 30% of a student's final course grade will consist of a research paper on a topic of the student's own choosing that utilizes spatial econometric techniques.

The research paper should adhere to the following guidelines in order to successfully complete the assignment:

1) The final research paper must be a **minimum of 10 typewritten pages long** and can be prepared in a standard word processing program (e.g. Microsoft Word) or in LaTeX.

2) The final research paper should contain the following sections:

- Title
- Abstract
- Introduction
- Literature Review
- Data Section
- Econometrics Section/Model Section
- Results
- Conclusion

Students can also include alternative sections if their paper has a need for one, such as a theoretical section or other relevant section. Note that this outline is consistent with papers published in such journals as the *American Journal of Agricultural Economics* or the *American Economic Review*.

3) The student will be graded on the following elements:

- How well they follow the outline illustrated above
- How well they explain their ideas in written form
- How well the student explain the hypothesis of interest they are testing
- Spelling and grammar
- How well they explain the econometric technique utilized in the paper, i.e. correct usage of empirical techniques and correct usage of terminology.

Please note that students will not be graded on how the correctness of their results, i.e. students will not be penalized if their hypothesis of interest is not confirmed!