UP 504
Quantitative Methods for Planning

David Bieri Winter 2013

Lectures:	M W 9:00am–10:30am
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Course description

The primary objective of this course is to introduce students to some of the quantitative methods and techniques used in planning practice and research. We will cover computer applications for data analysis, including several computer lab sessions. The emphasis is on using methods in the context of planning, urban policy and regional science research, matching the method to the problem, developing an interactive engagement with data methods, promoting creative and accessible styles of data presentation, and developing a critical literacy of data and methods.

This course also introduces students to the fundamentals of more advanced regression techniques, such as instrumental variable estimation via Two-Stage Least Squares (2SLS) and binary choice, limited dependent variable models and time series regression analysis. Reflecting the growing importance of GIS as a tool for planners, this course provides an introduction to key methods and applications in spatial data analysis, including a cursory overview of spatial statistics.

Prerequisites

UP503 or equivalent. If you waived out of UP503, please review the syllabus from the course as taught during Fall 2012. You are expected to know this material, including probability, sample size, ANOVA, confidence intervals, hypothesis testing, and bivariate regression. You are advised to review these methodologies beforehand. We will immediately jump into multiple regression, building upon your past coursework.

Software

You should be familiar with the basics of a spreadsheet programm such as Excel or its open-source equivalent OpenOffice Calc. We will use R, an implementation of the object-oriented mathematical programming language S, for most of the data analysis, graphing and regression modelling. R is an integrated suite of open-source statistical and graphical software that is developed by statisticians around the world (www.r-project.org). In contrast to standard commercial packages such as SPSS or Stata, R is much more flexible because it is a modern mathematical programming language with capabilities similar

to those of MATLAB, not just a program that performs canned regression routines and tests. Furthermore, because it is free and does not command prohibitively expensive licensing fees, it is increasingly used by medium and small businesses and non-profit organisations. I recommend that you run R via the integrated development environment RStudio (which is also available through `virtualsites.umich.edu`). We will also use a cloud-based version of LaTeX, a typesetting system that is specialised for producing scientific and mathematical documents of high typographical quality.

Course Readings

Required texts

Dougherty, C. (2011): *Introduction to Econometrics*. Oxford University Press, 4th edn. [**ITE**]

Recommended texts

Bivand, R. S., E. J. Pebesma, and V. Gómez-Rubio (2008): *Applied Spatial Data Analysis with R*, Use R!, Springer, New York, NY. [**ASDAR**, electronic version available on CTools]

Dalgaard, P. (2008): *Introductory Statistics with R (Statistics and Computing)*, Use R!, Springer, New York, NY, 2nd edn. [**ISR**, electronic version available on CTools]

Pfaff, B. (2008): *Analysis of Integrated and Cointegrated Time Series in R*, Use R! Springer, New York, NY, 2nd edn.

Shumway, R. H., and D. S. Stoffer (2011): *Time Series Analysis and Its Applications With R Examples*, Springer Texts in Statistics. Springer, New York, NY, 3rd edn.

Getting started with R

Arai, M. (2009): "A Brief Guide to R for Beginners in Econometrics," Manual, Stockholm University.

Farnsworth, G. V. (2008): "Econometrics in R," Manual, Kellogg School of Management, Northwestern University.

Verzani, J. (2011): *Getting Started with RStudio*. O'Reilly Media.

Getting started with LaTeX

Oetiker, T., H. Partl, I. Hyna, and E. Schlegl (2011): "The Not So Short Introduction to LaTeX," Manual, Olten, Switzerland.

Online resources

Kabacoff, R. I. (2011): "Quick-R: Accessing the Power of R", online version of *R in Action: Data Analysis and Graphics with R*.

Short, T. (2004): "R Reference Card".

UCLA Academic Technology Services: "Resources to help you learn and use R".

Other assigned readings will be posted on CTools, see reading list below.

Course Requirements and Policies

Grading

This course will *not* be graded on a curve. This means that the number of top grades is not limited and – by symmetry – the same is also true for low grades. The course-specific grading scheme is as follows:

- Homework assignments (equally weighted) – 40%
- Midterm exam (in class) – 25%
- Final exam (take home) – 30%
- Class participation – 5%

Details on each of these assignments will be provided in class.

Late or missed assignments

All work must be submitted by the due date. Late work will be accepted with a penalty of *50% per lecture* past the due date. Exceptions to these rules are not granted without a note from the Dean of Students Office detailing why an excuse should be warranted. Usually, make-up exams will be oral, given as close to the exam date as possible.

Attendance policy

You are responsible for all material discussed in class. Students are expected to have read all assigned material before class so that they can take an active role in class discussions. Readings are complements, not substitutes for class attendance.

Policy on plagiarism and academic honesty

The University of Michigan Honor Code is in effect for this course. Please take the time to read this document and make sure that you understand your responsibilities as a student. I assume that everything you turn in during the semester conforms to the Honor Code and to the usual academic standards governing appropriate student conduct. It is your responsibility to find out what constitutes plagiarism and cheating; a plea of ignorance is not acceptable as a defense. The following statement, taken from the Rackham Graduate School's Statement on Graduate Academic and Professional Integrity, describes the types of violations covered under the Honor System:

> A clear sense of academic honesty and responsibility is fundamental to our scholarly community. To that end, the University of Michigan expects its students to demonstrate honesty and integrity in all their academic activities [...] As professionals in training, graduate students assume various roles, depending on the academic program. These include the roles of scholar/researcher, teacher, supervisor of employees, representative to the public (of the University, the discipline and/or the profession), and professional colleague and even the role of provider of services to clients. Therefore, students are responsible for maintaining high standards of conduct while engaged in course work, research, dissertation or thesis preparation, and other activities related to academics and their profession.
>
> Graduate training, like future professional life, includes demands that might tempt some students to violate integrity standards. There are pressures on graduate students to

> achieve high grades, obtain financial support, meet research or publication deadlines, gain recognition from the scholarly community, and secure employment. Although faculty members can help students to maintain academic integrity despite these pressures, each student has final responsibility for maintaining integrity in his or her individual conduct.
>
> Finally, conduct that violates the ethical or legal standards of the University community or of ones program or field of specialization may result in serious consequences, including immediate disciplinary action and future professional disrepute. In support of the Graduate Schools commitment to maintain high standards of integrity, this policy makes provisions for bringing forward and hearing cases of academic and professional misconduct.

Be advised that plagiarism or other forms of violations of the University of Michigan Honor Code will not be tolerated. I will not hesitate to forward cases of academic dishonesty to the Dean.

Class room etiquette

Everyone who registers for this class is an adult. You are legally able to marry without parental consent, buy a home, pay taxes, vote, work, budget your money, defend your country in military service, etc. You should also be adult enough not to disturb others.

No electronic devices of any kind will be needed for this course, unless stated otherwise. Please stow away your laptops and mobile phones for the entire duration of the lecture.

CTools

The CTools site for UP 504 is an important component of this course. With similar functionality to Blackboard, CTools is an online environment and UP 504 is assigned a separate page within CTools and is accessible only by the course instructor and the students enrolled in the course. This system provides a convenient way to post announcements, grades, assignments, and online quizzes or homework.

You are responsible for any announcement or assignment posted on CTools, regardless of whether the announcement or assignment was discussed in class. I recommend checking CTools on a regular basis.

Tentative Course Calendar

	Topic	*Lectures*	*Readings*
I.	Introduction and Review	1/1 – 3/1	ITE-R, ISR1–2
II.	Data Sources	3/2 – 4/1	
III.	Data Manipulation, Org. and Class.	4/2 – 5/2	ISR3–4
	(i) Transformation of variables		ITE4, ISR10
	(ii) Cluster analysis		
IV.	Regression Techniques	6/1 – 8/2	ITE2
	(i) Multiple regression analysis		ITE3, ISR5
	(ii) Confidence intervals		ISR6
	(iii) Dummy variables		ITE5, ISR10
	(iv) Heteroskedasticity		ITE7
V.	Beyond OLS	9/1 – 10/1	
	(i) Measurement error		ITE8
	(ii) Instrumental variables, 2SLS		
	(iii) Multinomial choice models, quantile regression		ITE10

VI.	Economic Analysis	10/2 – 11/2	
	(i) Inequality measures		
	(ii) Spatial concentration and agglomeration		
VII.	Time Series Analysis	12/1 – 13/1	ITE11
	(i) Autocorrelation and non-stationarity		ITE12–13
	(ii) Principles of forecasting		
VIII.	Spatial Data Analysis	13/2 – 15/1	ASDR1,3
	(i) Spatial point pattern analysis		ASDR7
	(ii) Geostatistics		ASDR8
	(iii) Spatial autocorrelation		ASDR9–10

Note: The three-letter textbook abbreviation followed by a number indicates a given chapter in that textbook, e.g. ITE4 refers to chapter 4 in the Dougherty text. Additional readings from the reading list below will be assigned to individual lectures.

Important dates during the semester

Please take note of the following dates over the course of the semester:[1]

M	21 Jan 13	Martin Luther King, Jr. Day. No Class.
W	30 Jan 13	Exercise 1 due.
T	29 Jan 13	Last day for students to add/drop Winter 2013 classes.
M	11 Feb 13	Exercise 2 due.
M	25 Feb 13	Exercise 3 due.
W	27 Feb 13	Midterm exam in class.
S	2 Mar 13	Spring break recess begins.
S	10 Mar 13	Spring break recess ends.
W	13 Mar 13	Exercise 4 due.
M	1 Apr 13	Exercise 5 due.
M	15 Apr 13	Exercise 6 due.
W	17 Apr 13	Final exam handed out.
T	23 Apr 13	Classes end.
W	24 Apr 13	Final exam due (1pm).

Detailed Reading List

Compulsory readings are marked by an asterisk (*). The rest of the reading is optional, and intended for those interested in pursuing particular topics in more depth. I would encourage you to do as much of the reading as possible. Please familiarise yourself with the material before the lectures, which should enable us to engage in interesting and informed class discussions.

I. Introduction and review

Lecture 1/1: 9 January 2013 (W)

Introduction, syllabus review and key concepts.

Lecture 2/1: 14 January 2013 (M)

Review: Statistics, basic matrix algebra, probability theory.

*ITE, chapters R–1.

*Contant, C. K., and D. J. Forkenbrock (1986): "Planning Methods: An Analysis of Supply and Demand," *Journal of Planning Education and Research*, 6(1), 10–21.

*Davidson Schuster, J. M. (1986): "Quantitative Reasoning in the Planning Curriculum," *Journal of Planning Education and Research*, 6(1), 30–36.

*Kaufman, S., and R. Simons (1995): "Quantitative and Research Methods in Planning: Are Schools Teaching What Practitioners Practice?," *Journal of Planning Education and Research*, 34(1), 17–33.

Lecture 2/2: 16 January 2013 (W)

Introduction to R, basic data manipulation.

[1] Dates are subject to change.

*ISR, chapters 1–2.

*Angrist, J. D., and J.-S. Pischke (2009): *Mostly Harmless Econometrics: An Empiricist's Companion* chap. Questions about Questions, pp. 3–8. Princeton University Press, Princeton, NJ.

Lecture 3/1: 21 January 2013 (M)

MLK Day, no class.

II. Data Sources

Lecture 3/2: 23 January 2013 (W)

Census geography, PUMS data.

*Census (2008): *A Compass for Understanding and Using American Community Survey Data: What General Data Users Need to Know*, U.S. Census Bureau, U.S. Department of Commerce, Economics and Statistics Administration, Washington, DC.

*Isserman, A. M. (2005): "In the National Interest: Defining Rural and Urban Correctly in Research and Public Policy," *International Regional Science Review*, 28(4), 465–499.

*Torrieri, N. K. (2005): "Geographic Overview" chapter 2 in *Geographic Areas Reference Manual*, U.S. Department of Commerce, Bureau of the Census, Washington, DC.

Torrieri, N. K. (2005): "The Urban and Rural Classifications" chapter 12 in *Geographic Areas Reference Manual*, U.S. Department of Commerce, Bureau of the Census, Washington, DC.

Torrieri, N. K. (2005): "Metropolitan Areas" chapter 13 in *Geographic Areas Reference Manual*, U.S. Department of Commerce, Bureau of the Census, Washington, DC.

*Wallman, K. K. (2010): "Federal Statistics: Understanding a Crucial Resource," *Annals of the American Academy of Political and Social Science*, 631(1), 22–24.

Lecture 4/1: 28 January 2013 (M)

Key data sources for quantitative planning.

County Business Patterns, ATUS-CPS connection, BEA, BLS, Data Driven Detroit (D3), HUDUser, City of Chicago Data Portal, Federal Reserve Economic Data (FRED), USGS National Atlas, NOAA Climate Data.

Isserman, A. M., and J. Westervelt (2006): "1.5 Million Missing Numbers: Overcoming Employment Suppression in County Business Patterns Data," *International Regional Science Review*, 29(3), 311–335.

Panek, S. D., F. T. Baumgardner, and M. J. McCormick (2007): "Introducing New Measures of the Metropolitan Economy: Prototype GDP-by-Metropolitan-Area Estimates for 2001–2005," *BEA Survey of Current Business*, 87(11), 79–113.

III. Data Manipulation, Organisation and Classification

Lecture 4/2: 30 January 2013 (W)

Descriptive statistics and graphics, cross tabulations; Exercise 1 due.

*ISR, chapters 3–4.

Hamermesh, D. S. (2007): "Viewpoint: Replication in Economics," *Canadian Journal of Economics*, 40(3), 715–733.

Lecture 5/1: 4 February 2013 (M)

Transformation of variables.

*ITE, chapter 4.

*ISR, chapter 10.

Lecture 5/2: 6 February 2013 (W)

Classification: Principal component analysis, cluster analysis, discriminant analysis.

*Vicino, T. J., B. Hanlon, and J. R. Short (2011): "A Typology of Urban Immigrant Neighborhoods," *Urban Geography*, 32(3), 383–405.

IV. Regression Techniques

Lecture 6/1: 11 February 2013 (M)

Causal inference in social science; Exercise 2 due.

ITE, chapter 2.

*Angrist, J. D., and J.-S. Pischke (2009): *Mostly Harmless Econometrics: An Empiricist's Companion* chap. The Experimental Ideal, pp. 9–16. Princeton University Press, Princeton, NJ.

Heckman, J. J., and J. A. Smith (1995): "Assessing the Case for Social Experiments," *Journal of Economic Perspectives*, 9(2), 85–110.

*Holland, P. W. (1986): "Statistics and Causal Inference," *Journal of the American Statistical Association*, 81(396), 945–960.

*Sobel, Michael, E. (2000): "Causal Inference in the Social Sciences," *Journal of the American Statistical Association*, 95(450), 647–651.

Winship, C., and S. L. Morgan (1999): "The Estimation of Causal Effects from Observational Data," *Annual Review of Sociology*, 25(1), 659–706.

Lecture 6/2: 13 February 2013 (W)

Multiple regression analysis.

*ITE, chapter 3.

ISR, chapter 5.

Leamer, E. E. (1983): "Let's Take the Con Out of Econometrics," *American Economic Review*, 73(1), 31–43.

Morgan, S. L., and C. Winship (2007): *Counterfactuals and Causal Inference: Methods and Principles for Social Research* chap. Introduction, pp. 1–30, Analytical Methods for Social Research. Cambridge University Press, New York, NY.

Lecture 7/1: 18 February 2013 (M)

Confidence intervals, bootstrapping.

*ISR, chapter 6.

Lecture 7/2: 20 February 2013 (W)

Dummy variables.

*ITE, chapters 5.

ISR, chapter 11.

Lecture 8/1: 25 February 2013 (M)

Heteroskedasticity; Exercise 3 due.

*ITE, chapter 7.

*ISR, chapter 12.

Lecture 8/2: 27 February 2013 (W)

Midterm Exam, in class.

V. Beyond OLS

Lecture 9/1: 11 March 2013 (M)

Measurement error, identification.

*ITE, chapters 8.

*Hausman, J. (2001): "Mismeasured Variables in Econometric Analysis: Problems from the Right and Problems from the Left," *Journal of Economic Perspecitves*, 15(4), 57–67.

Lecture 9/2: 13 March 2013 (W)

Instrumental variables (IV), Two-Stage Least Squares (2SLS); Exercise 4 due.

*ITE, chapter 9.

Angrist, J. D., G. W. Imbens, and D. B. Rubin (1996): "Identification of Causal Effects Using Instrumental Variables," *Journal of the American Statistical Association*, 91(434), 444–455.

*Angrist, J. D., and A. B. Krueger (2001): "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments," *Journal of Economic Perspectives*, 15(4), 69–85.

Murray, M. P. (2006): "Avoiding Invalid Instruments and Coping with Weak Instruments," *Journal of Economic Perspecitves*, 20(4), 111–132.

Lecture 10/1: 18 March 2013 (M)

Binary reponse models, multinomial choice models, quantile regression.

*ITE, chapter 10.

ISR, chapter 13.

*Horowitz, J. L., and N. E. Savin (2001): "Binary Response Models: Logits, Probits and Semiparametrics," *Journal of Economic Perspectives*, 15(4), 43–56.

*Koenker, R., and K. F. Hallock (2001): "Quantile Regression," *Journal of Economic Perspectives*, 15(4), 143–156.

VI. Economic Analysis

Lecture 10/2: 20 March 2013 (W)

Modelling and measuring economic activity (LQs, shift-share analysis).

Cortright, J., and A. Reamer (1998): "Socioeconomic Data for Understanding Your Regional Economy: A User's Guide," Discussion paper, Economic Development Administration, U.S. Department of Commerce.

*Bilheimer, L. (2012): "Using Analytic Models and Communicating Their Findings," Congressional Budget Office, Presentation, November.

*Donegan, M., J. Drucker, H. Goldstein, N. Lowe, and E. Malizia (2008): "Which Indicators Explain Metropolitan Economic Performance Best?," *Journal of the American Planning Association*, 74(4), 180–195.

Knudsen, D. C. (2000): "Shift-share Analysis: Further Examination of Models for the Description of Economic Change," *Socio-Economic Planning Sciences*, 34(1), 177–198.

Moretti, E. (2010): "Local Multipliers," *American Economic Review: Papers & Proceedings*, 100(3), 1–7.

RIM2 (1997): *Regional Mutlipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)*, U.S. Department of Commerce, Bureau of Economic Analysis, Washington, D.C., third edn.

Lecture 11/1: 25 March 2013 (M)

Measuring inequality (Gini coefficient, Theil index, entropy).

Portnov, B. A., and D. Felsenstein (2010): "On the Suitability of Income Inequality Measures for Regional Analysis: Some Evidence from Simulation Analysis and Bootstrapping Tests," *Socio-Economic Planning Sciences*, 44(2), 212–219.

*Wilson, R. E. (2011): "Visualizing Racial Segregation Differently – Exploring Changing Patterns From the Effect of Underlying Geographic Distributions," *Cityscape: A Journal of Policy Development and Research*, 13(2), 163–174.

*World Bank Institute (2005): *Introduction to Poverty Analysis* chap. Inequality Measures. Washington, DC: World Bank Publications.

Lecture 11/2: 27 March 2013 (W)

Spatial concentration and agglomeration.

*Ellison, G., and E. L. Glaeser (1997): "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach," *The Journal of Political Economy*, 105(5), 889–927.

Figueiredo, O., P. Guimarães, and D. Woodward (2009): "Localization Economies and Establishment Size: Was Marshall Right After All?," *Journal of Economic Geography*, 9(6), 805–822.

*Guimarães, P., O. Figueiredo, and D. Woodward (2011): "Accounting for Neighbouring Effects in Measures of Spatial Concentration," *Journal of Regional Science*, 51(4), 678–693.

Moineddin, R., J. Beyene, and E. Boyle (2003): "On the Location Quotient Confidence Interval," *Geographic Analysis*, 35(3), 249–256.

VII. Time Series Analysis

Lecture 12/1: 1 April 2013 (M)

Introduction and key concepts; Exercise 5 due.

*ITE, chapter 11.

Lecture 12/2: 3 April 2013 (W)

Autocorrelation and non-stationarity.

ITE, chapters 12–13.

Lecture 13/1: 8 April 2013 (M)

Principles of forecasting.

*Diebold, F. X. (1998): "The Past, Present, and Future of Macroeconomic Forecasting," *Journal of Economic Perspecitves*, 12(2), 175–192.

VIII. Spatial Data Analysis

Lecture 13/2: 10 April 2013 (W)

Introduction and key concepts.

ASDR, chapters 1 and 3.

*Anselin, L. (2012): "From SpaceStat to CyberGIS: Twenty Years of Spatial Data Analysis Software," *International Regional Science Review*, 35(2), 131–157.

Bivand, R. S. (2006): "Implementing Spatial Data Analysis Software Tools in R," *Geographical Analysis*, 38(1), 23–40.

*Buckley, E. (2013): "Understanding Statistical Data for Mapping Purposes," *ArcUser*, Winter, online version.

Gotway, C. A., and L. J. Young (2002): "Combining Incompatible Spatial Data," *Journal of the American Statistical Association*, 97(458), 632–648.

Lecture 14/1: 15 April 2013 (M)

Spatial point pattern analysis; Exercise 6 due.

ASDR, chapter 7.

*Gibbons, S., and H. G. Overman (2012): "Mostly Pointless Spatial Econometrics?," *Journal of Regional Science*, 52(2), 172–191.

Lecture 14/2: 17 April 2013 (W)

Interpolation and geostatistics, modifiable areal unit problem (MAUP).

ASDR, chapter 8.

*Briant, A., P.-P. Combes, and M. Lafourcade (2010): "Dots to Boxes: Do the Size and Shape of Spatial Units Jeopardize Economic Geography Estimations?," *Journal of Urban Economics*, 67(3), 287–302.

*Fotheringham, A. S., and D. W. S. Wong (1991): "The Modifiable Areal Unit Problem in Multivariate Statistical Analysis," *Environment and Planning A*, 23(7), 1025–1044.

Grubesic, T. H. (2008): "Zip Codes and Spatial Analysis: Problems and Prospects," *Socio-Economic Planning Sciences*, 42(2), 129–149.

Menon, C. (2012): "The Bright Side of MAUP: an Enquiry on the Determinants of Industrial Agglomeration in the United States," *Papers in Regional Science*, 91(1), 3–29.

Lecture 15/1: 22 April 2013 (M)

Areal data and spatial autocorrelation.

ASDR, chapters 9–10.