Quantitative Geographical Analysis

Spring, 2001
450:606:01 (index 49995), 450:492:01 (index 40448)
Mondays, 6:10-9:00 PM, LSH B-231, Livingston Campus
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This course is a critical survey of quantitative analysis in geography, with particular emphasis on multivariate and spatial-analytic applications. We examine three main questions: What are the assumptions, analytical possibilities, and limitations of quantitative approaches to geographic problems? What kinds of analytical methods and modeling techniques are available for specific geographic research questions? How does the choice of a particular method or technique reflect and influence the trajectory of a geographical research agenda?

Or, to put it in simpler terms: *what issues should you consider in using quantitative approaches in your research?*

Readings and projects are selected to highlight a diverse range of quantitative approaches and applications; but the scope of the course will depend partly on the interests and expertise of course participants. Case studies of particular quantitative approaches include cluster analysis, ecological inference, principal components and factor analysis, multiple regression, logistic regression, expansion techniques, spatial econometrics, and Q analysis.

Objectives

After taking this course, you will be able to:

1. Describe the range of quantitative methodologies and techniques used in your chosen field of specialization;

2. Understand (and stake a position in) contemporary debates over the epistemological status, theoretical contributions, and applied relevance of quantitative analysis in geography;

3. Understand the uses and limitations of a selection of multivariate quantitative techniques in geographical research.

4. Develop a comprehensive methodological framework, including theoretical foundations as well as a menu of specific techniques, to guide your research agenda. This goal is designed to provide an opportunity to define and defend a methodology that may be used in a doctoral dissertation, masters thesis, or honors project.

I want you to consider each of these objectives carefully. But I also want you to notice what is not on this list. This seminar is more than a "how-to" course, and so you will not be required to memorize every step in the derivation of a mathematical function or statistical procedure. Although you will need to learn several specific techniques, the central concern is how different kinds of research problems necessitate different families of quantitative methods. We are also concerned with questions that must be confronted *prior to* and *after* the analytical procedures used in specific research traditions. What are the underlying assumptions of quantitative analysis in geography, and how do these assumptions differ from those recognized in other disciplines? What kinds of analytical approaches are used most widely in particular subfields? How are certain sets of multivariate techniques used in specifically geographical research questions?

Requirements:

This course is simultaneously a research seminar for graduate students in geography and allied fields, and a specialized methods course suitable for advanced undergraduates. This means that its value to you depends heavily on your investment. Each of us brings to the table a distinctive mixture of expertise, preferences, goals, experiences, and ways of thinking. By engaging in a systematic, rigorous, but open colloquy, we gain insight on alternative perspectives, interpretations, and applications of theories and methods used in the discipline. But doing this requires careful reading, disciplined preparation, and active participation.

1. Attendance, reading, and active participation in class discussion (20%). Participation also includes co-leading two seminar discussions, and a brief oral presentation of the findings of a paper (see below). Requirements for seminar leaders will be discussed during the first class.

2. Completion of two short take-home assignments (15% each). These projects involve short problem sets and written essays evaluating selected techniques and readings. The first project will be distributed on February 26, and is due on March 12. The second project will be distributed on April 16, and is due on April 23.

3. Research and writing of a seminar paper (50%). The paper should focus on a theoretical, methodological, applied, or policy dimension of quantitative research in geography or allied fields of inquiry. Detailed guidelines on paper requirements will be provided in the first weeks of the class. A preliminary, one-page single-spaced proposal on your paper topic is due on February 5; you should include a select bibliography (of any length) listing the sources (literature and/or data sources) you anticipate using in your research. You will receive comments on your proposal by February 12; a revised proposal responding to these comments is due on February 26. Your final paper should be at least 7,500 words, not including references and/or notes (depending on fonts and other technical choices, this is about twenty-five double-spaced pages). The final paper is due no later than 11:00 PM on Monday, May 7th.

The course includes both lecture and seminar components. The course does not include a formal lab component; but many of the quantitative techniques we examine will be illustrated in SAS, a common statistical package available on rci and in the Department's graduate research lab.

Alternative, specialized software packages will be introduced to illustrate ecological analysis, multilevel modeling, and other techniques. Reading requirements are rigorous, and drawn from diverse quarters of the literature as well as a core text: Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. *Quantitative Geography: Perspectives on Spatial Data Analysis*. London: Sage Publications.

Schedule and Readings

January 22 . Introduction.
Course introduction; current debates and problems in quantitative geographical research; importance of the "ologies;" logic and structure of the course. Transactional details: expectations, assumptions, and possibilities. Software.

Livingstone, David. 1992. "Statistics Don't Bleed: Quantification and its Detractors." *The Geographical Tradition*, 304-346. London: Blackwell.

January 29. The History and Present Condition of Quantitative Geography.
Revolutions, quantitative and otherwise. The analytical possibilities and implicit assumptions of positivism, quantification, and modeling.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. "Establishing the Boundaries." *Quantitative Geography: Perspectives on Spatial Data Analysis*, 1-14. London: Sage Publications.

Massey, Doreen. 1993. "The Different Sides of the 'Sixties." *Environment and Planning A*, Anniversary Issue, 10-13.

Driver, Felix. 1993. "Back to the Future of Geography." *Environment and Planning A*, Anniversary Issue, 22-25.

Rose, Gillian. 1993. "Speculations on What the Future Holds in Store." *Environment and Planning A*, Anniversary Issue, 26-29.

Fotheringham, A. Stewart. 1993. "On the Future of Spatial Analysis: The Role of GIS." *Environment and Planning A*, Anniversary Issue, 30-34.

Gould, Peter. 1981. "Letting the Data Speak for Themselves." *Annals of the Association of American Geographers* 71(2), 166-176.

February 5 . Three Givens.
Three meanings of "data." Distinctive qualities of spatial data. The methodological (and political) implications of abstraction, aggregation, and inference: the multiracial census debate; the geography of HIV/AIDS.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. "Spatial Data." *Quantitative Geography: Perspectives on Spatial Data Analysis*, 15-29. London: Sage Publications.

Anderson, Margo, and Stephen E. Fienberg. 2000. "Race and Ethnicity and the Controversy over the U.S. Census." *Current Sociology* 48(3), 87-110.

Longley, Paul. 1999. "Understanding Income Distributions in Urban Systems." *Computers, Environment, and Urban Systems* 23, 333-337.

Gould, Peter. 1995. "Sources of Error in a Map Series, or Science as a Socially Negotiated Enterprise." *Cartographic Perspectives* 21, 30-36.

Cochrane, Michelle. 2000. "The Politics of AIDS Surveillance." *Professional Geographer* 52(2), 205-218.

February 12 . Inference and Fallacy: The Ecological Dilemma.
Problems of spatial aggregation. The long-intractable ecological problem and a proposed solution. The modifiable areal unit problem.

Sui, Daniel. 2000. "New Directions in Ecological Inference: An Introduction." *Annals of the Association of American Geographers* 90(3), 579-582.

Fotheringham, A. Stewart. 2000. "A Bluffer's Guide to A Solution to the Ecological Inference Problem." *Annals of the Association of American Geographers* 90(3), 582-586.

Anselin, Luc. 2000. "The Alchemy of Statistics, or Creating Data Where No Data Exist." *Annals of the Association of American Geographers* 90(3), 586-592.

O'Loughlin, John. 2000. "Can King's Ecological Inference Method Answer a Social Scientific Puzzle: Who Voted for the Nazi Party in Weimar Germany?" *Annals of the Association of American Geographers* 90(3), 592-601.

King, Gary. 2000. "Geography, Statistics, and Ecological Inference." *Annals of the Association of American Geographers* 90(3), 601-606.

February 19 . Automating Linnaeus: Possibilities and Perils of Classification.
Numerical taxonomy: classifying things ('observations') by measuring characteristics ('variables') in an n-dimensional space. Recent advances in classification. What happens when *we* are the observations, and (certain facets of) our choices constitute the variables? Methodological, epistemological, and political implications of numerical taxonomy.

Wilson, John P., and Peter A. Burroughs. 1999. "Dynamic Modeling, Geostatistics, and Fuzzy Classification: New Sneakers for a New Geography?" *Annals of the Association of American Geographers* 89(4), 736-746.

Longley, Paul. 2000. "Spatial Analysis in the New Millennium." *Annals of the Association of American Geographers* 90(1), 157-165.

Goss, Jon. 1995. "We Know Who You Are and We Know Where You Live: The Instrumental Rationality of Geodemographic Systems." *Economic Geography* 71(2), 171-198.

Gould, Peter. 1999. "Do Foraminifera Assemblages Exist ~ At Least in the Persian Gulf?" In *Becoming A Geographer*, 289-299. Syracuse, NY: Syracuse University Press.

February 26. Exploring the Matrix: Principal Components Analysis and Factor Analysis.
Geometric approaches to principal components analysis. Eigenvalues, eigenvectors, and component scores. Rotations. Possibilities and pitfalls of meaning and interpretation. Conceptual meaning of latent, "unobserved" variables.

Goddard, John B. 1970. "Functional Regions Within the City Centre: A Study by Factor Analysis of Taxi Flows in Central London." *Transactions of the Institute of British Geographers* 49, 171-182.

Skönes, H.M., and R.G.H. Bunce. 1997. "Directions of Landscape Change (1741-1993) in Virestad, Sweden, Characterised by Multivariate Analysis." *Landscape and Urban Planning* 38, 61-75.

Kaplan, David H. 1996. "What is Measured in Measuring the Mortgage Market." *Professional Geographer* 48(4), 356-367.

Webster, Gerald R. 1996. "Partisan Shifts in Presidential and Gubernatorial Elections in Alabama, 1932-1994." *Professional Geographer* 48(4), 379-391.

Wyly, Elvin K. 1999. "Continuity and Change in the Restless Urban Landscape." *Economic Geography* 75(4), 309-338.

Holsman, Andy. 1980. "Higher-Order Factor Analysis and its Application to Transport Networks." *Professional Geographer* 32(2), 192-198.

March 5. Maps, Spatial Pattern, and Statistical Inference.

Goodchild, Michael F. 1992. "Analysis." In *Geography's Inner Worlds*, ed. Ronald F. Abler, Melvin G. Marcus, and Judy M. Olson, 138-162. New Brunswick, NJ: Rutgers University Press.

Taylor, Peter J. 1977. Excerpt, "Areal Association." In *Quantitative Methods in Geography*, 173-202. Prospect Heights, IL: Waveland Press.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. "Exploring Spatial Data Visually." *Quantitative Geography: Perspectives on Spatial Analysis*, 65-72. London: Sage Publications.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. "Statistical Inference for Spatial Data." *Quantitative Geography: Perspectives on Spatial Data Analysis*, 65-72. London: Sage Publications.

March 19. Multiple Regression.
Exensions from bivariate correlation and regression. Statistical (and geographical) assumptions of the general linear model. An intellectual and scientific geneology of regression.

Taylor, Peter J. 1977. Excerpt, "Areal Association." In *Quantitative Methods in Geography*, 203-219. Prospect Heights, IL: Waveland Press.

Goldstein, H. 1994. "The Use of Regression Analysis for Resource Allocation by Central Government." *Environment and Planning C*, 12, 15-21.

Barnes, Trevor J. 1998. "A History of Regression: Actors, Networks, Machines, and Numbers." *Environment and Planning A*, 30, 203-223.

March 26. Logistic Regression.
Binary response variables and the pitfalls of OLS regression. Logistic regression procedures and applications.

Wrigley, Neil. 1985. Excerpts from *Categorical Data Analysis for Geographers and Environmental Scientists*, pp. 21-30, 35-45. London: Longman.

Mortens, Benôit, and Eric F. Lambin. 2000. "Land-Cover Change Trajectories in Southern Cameroon." *Annals of the Association of American Geographers* 90(3), 467-494.

Pattie, Charles, and Ron Johnston. 2000. "People Who Talk Together Vote Together: An Exploration of Contextual Effects in Great Britain." *Annals of the Association of American Geographers* 90(1), 41-66.

Holloway, Steven R. 1998. "The Role of Residential Location in Conditioning the Effect of Metropolitan Economic Structure on Male Youth Employment." *The Professional Geographer* 50(1), 31-45.

April 2. Context and Contingency: The Expansion Method.
Theoretical foundations of contextual approaches to the multiple regression framework. Examples of expansion regressions.

Jones, John Paul, III, and Robert Q. Hanham. 1995. "Contingency, Realism, and the Expansion Method." Geographical Analysis 27(3), 185-207.

Kodras, Janet E. 1992. "A Contextual Expansion of the Welfare Model." In *Applications of the Expansion Method*, edited by John Paul Jones, III, and Emilio Casetti, 63-93. New York: Routledge.

Krakover, Shaul, and Richard L. Morrill. 1992. "Long-Wave Spatial and Economic Relationships in Urban Development." In *Applications of the Expansion Method*, edited by John Paul Jones, III, and Emilio Casetti, 161-184. New York: Routledge.

Miles, Martin, Douglas A. Stow, and John Paul Jones, III. 1992. "Incorporating the Expansion Method into Remote Sensing-Based Water Quality Analyses." In *Applications of the Expansion Method*, edited by John Paul Jones, III, and Emilio Casetti, 279-296. New York: Routledge.

April 9. Local Analysis and Spatial Regression.
Flaws in global and aspatial models. Local indicators of spatial association. Multilevel models and geographically weighted regression.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. "Local Analysis." *Quantitative Geography: Perspectives on Spatial Data Analysis*, 93-129. London: Sage Publications.

Duncan, Craig, and Kelvyn Jones. 2000. "Using Multilevel Models to Model Heterogeneity: Potential and Pitfalls." Geographical Analysis 32(4), 279-305.

Holloway, Steven R. 1998. "Exploring the Neighborhood Contingency of Race Discrimination in Mortgage Lending in Columbus, Ohio." Annals of the Association of American Geographers 88(2), 252-276.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. "Spatial Regression and Geostatistical Models." *Quantitative Geography: Perspectives on Spatial Data Analysis*, 162-183. London: Sage Publications.

April 16. A Language of Structural Relations: Q Analysis.
Abandoning mechanism. Are we imposing a function where there is only a mapping or a relation? Sets and matrices. Simplexes, complexes, and cover sets. Backcloth and traffic.

Atkin, Ronald H. 1974. "Ideas Associated with Set Theory." Chapter 1 in *Mathematical Structure in Human Affairs*, 1-21. New York: Crane, Russak and Company.

Atkin, Ronald H. 1974. "People and Complexes." Chapter 2 in *Mathematical Structure in Human Affairs*, 22-46. New York: Crane, Russak and Company.

Gould, Peter, J. Johnson, and Graham Chapman. 1984. "Describing Television Programmes." Chapter T3 in *The Structure of Television*, T29-T66. London: Pion.

Tripathi, Suprabha. 2000. "Health-Seeking Behavior: Q-Structures of Rural and Urban Women in India with Sexually-Transmitted Diseases and Reproductive Tract Infections." *Professional Geographer* 52(2), 218-232.

Adams, Paul. 1998. "Network Topologies and Virtual Place." *Annals of the Association of American Geographers* 88(1), 88-106.

April 23. Presentation of Individual Projects, Part 1.

Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. "Challenges in Spatial Data Analysis." *Quantitative Geography: Perspectives on Spatial Data Analysis*, 236-248. London: Sage Publications.

April 30. Presentation of Individual Projects, Part 2.

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FINAL PAPER DUE: 11:00 PM, Monday, May 7.