Incorporating Intermodal Transportation into the Spatially Integrated Social Sciences

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A Partnership Between

The Department of Geography and Planning
The Department of Economics
The Department of Sociology and Anthropology
The Department of Political Science and Public Administration
The University of Toledo Intermodal Transportation Institute

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Abstract

The purpose of this project is to expand the role of intermodal transportation in the newly approved Spatially Integrated Social Science Ph.D. Program to be administered jointly between the Departments of Geography and Planning, Economics, Political Science and Public Administration, and Sociology and Anthropology at The University of Toledo. The particular transportation-related areas of interest the SISS program offers that complement the UT UTC will be in the areas of Transportation for National Security, Transportation and Regional Economic Development, Infrastructure Utilization, and the spatial dimensions of Supply Chains. Each of these topics readily lends themselves to the faculty expertise, the available geospatial technology, and the regional economic needs of northwest Ohio. Furthermore, the SISS faculty will focus on the passenger movement among all modes of the transportation system and in the conflicts that arise between the movements of freight passenger modes. Specific areas of transportation research and teaching will include: 1) Transportation and urban form; 2) Transportation, Public Administration and Policy; 3) Transportation Analysis and Quantitative Methods; 4) Intermodal Transportation—Passenger and Freight; 5) Infrastructure Utilization and Planning; and 6) Transportation and the Environment. It is anticipated that transportation and all of its spatial dimensions will play a pivotal role in this program and will attract students with an interest in combining an analytical approach to studying transportation, but from a perspective that appreciates the contribution of diverse social science disciplines to understanding this important spatial process.

Keywords: Transportation, information organization

Subject Categories: Data and Information Technology, Freight, Intermodal

Introduction

The University of Toledo College of Arts and Sciences is now offering a multidisciplinary Doctor of Philosophy Degree in ***Spatially-Integrated Social Science*** as a cooperative venture between the departments of Geography and Planning, Economics, Political Science and Public Administration, and Sociology and Anthropology. The program is designed around the application of geographic information science, spatial econometrics and related spatial analysis approaches to study the spatial dimension of human and social dynamics, including interaction of individuals and society, government, and market participants. This program will enhance the allied social science's role in UT's mission as a metropolitan urban university and will strengthen the university's efforts in outreach, research and education.

This program will focus on space as a unifying theme under which social scientists can examine social, political and economic processes over the landscape. The location and distribution of populations and the social processes that influence those populations will thus form the basis upon which the relevant data associated with these phenomena are assembled, organized, displayed and analyzed. This approach is underscored by the Center for Spatially Integrated Social Science (CSISS):

> CSISS recognizes the key role space plays in human society, and promotes research that advances our understanding of spatial patterns and processes. Cartographic visualization, geographic information systems (GIS), pattern recognition, spatially sensitive statistical analysis, and place-based search methodologies are the tools of spatially integrated social science (SISS) used to integrate knowledge across disciplines and paradigms. From research design to the interpretation of research findings, the use of SISS can advance understanding in nearly every domain of the social and behavioral sciences (CSISS, 2003)

The following discussion for the degree program presented here is drawn from the program proposal submitted to the Ohio Board of Regents in 2007. The program's rationale is based on a rapidly growing commitment by social and behavioral scientists to incorporate geographic information processing technology to researches that focus on the social, economic, political, ethnic, and cultural elements of changing landscapes ranging from the local to the global scale (Goodchild, *et al*., 2000). Once considered the exclusive domain of geographers, this "space and place"-based approach is rapidly diffusing to a wider population of social scientists, which in turn results in a blurring of disciplinary boundaries and a blending of interdisciplinary pursuits. The spatial emphasis traditionally held by geographers must of necessity today be enhanced by a new spatio-temporal approach that is "multidimensional and therefore multidisciplinary, transcending the constraints of traditional disciplinary agendas and casting light on the interstices where today's important problems are located" (B.J.L. Berry, quoted in CSISS, 2003). Examples cited by the Center for Spatially Integrated Social Science (CSISS) and by Goodchild, *et al*., (2000) of major topics which transcend disciplinary boundaries and follow the spatio-temporal model are listed as follows[1]:

- Environmental and climate change
- Social and economic inequality
- Social and business networks
- Health and disease
- Cultural analysis / symbolic meaning of space
- Criminal justice
- Community studies / grassroots organizations
- Urban Studies.

This list is by no means a comprehensive set of topics for empirical research; additional interest areas within the group of allied departments include such diverse areas as: race and space issues, economic development, voting patterns and political redistricting, and transportation. On many levels it can be effectively argued that transportation is one of the most fundamental human functions; it is directly affected by space, but it is also affected by and influences each of the topics listed above. As a result, transportation as a process must play a pivotal role in the SISS Ph.D. program.

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[1]please consult pp. 142-148 in Goodchild, *et al*. (2000) and pp. C2-C5 in the *CSISS Project Description* (http://www.csiss.org/aboutus/reports/csiss_descript.pdf) for a more detailed treatment of these topics including cited work from the social science research literature.

While the link between transportation and other social processes certainly provides more than sufficient raw material for research, the major direction of this program is more specific. Research in the SISS Program will deal with the application of geospatial analysis technology for empirical investigations of transportation, society and space. Of greater significance to the program is the development of new spatial-analytic techniques and tools for investigations of space and its effect on social processes. A detailed examination of the literature in this area reveals considerable attention devoted to theoretical issues that extend into the wider field of spatial statistics and geographical information science. These include issues dealing with non-independence or autocorrelation between observations of geographic variables distributed over space, where similarity in measured observations of variables within close proximity precludes the direct application of traditional parametric statistical methods. As a result, a new body of statistical theory has emerged that is devoted to spatially-weighted regression analysis, error theory in spatially-distributed data, spatial interpolation and sampling methods, the effects of scale and resolution in geographically distributed data, the effect of scale and resolution in the understanding of spatial interaction, and the confounding effects of boundary alignment and modifiable areal units in data organization and analysis.

Significant advances in spatial information processing technologies--notably in the form of Geographic Information Systems (GIS)--have served as an important catalyst for this emerging spatio-temporal research paradigm. GIS has enabled more efficient collection, management and analysis of spatial data resulting in more efficient handling of social data to detect patterns and anomalies. Anselin (1999) refers to this process of *exploratory spatial data analysis* as a useful means of generating new and interesting hypotheses (CSISS, 2003). These developments have prompted observers of the technology to call for the social sciences to share in these technologies as noted by Goodchild, *et al*. (2000) and Sui (2004).

This important interface between the rapidly-developing geospatial technology and the interrelated interests shared by our faculty therefore forms the basis for our program where transportation will play a critical role. We have thus developed a multidisciplinary research degree program that can build upon the success achieved in the Center for Geographic Information Science and Applied Geographics (GISAG) in the Department Geography and Planning and the participating allied social science departments. Since its founding that accompanied an NSF Instrumentation Grant (Czajkowski, et al., 2003), the GISAG Center continues its success in sponsored research and outreach. Since its founding the center has served as an integral component of funded projects amounting to over $16 million. A sample of extramural funding organizations include: USDA, NSF, TMACOG, NASA, Midwest Regional University Transportation Center, C-FIRE, GLMRI, USACE, Ohio Department of Transportation, Lucas County Port Authority, City of Toledo, Black and Veatch Corp. and Sylvania (Ohio) Township. The overwhelming majority of the research initiatives focus on metropolitan-based projects that underscore the metropolitan mission of the university. Much of the research is also directed toward providing support in GIS and remote sensing for other projects ranging from environmental studies dealing with Lake Erie to local environmental and land use issues, as well as local and regional planning issues.

At the present time, the majority of research projects undertaken in the GISAG have been joint projects between Geography and Planning, Economics, Political Science, Environmental Sciences, Business Administration and Civil Engineering. The new degree program can build on this foundation to enhance research ties among faculty in the allied social science departments and in turn, produce the benefits of synergies derived by multidisciplinary collaboration.

The resources in the GISAG have greatly assisted in this endeavor to produce the following sample of projects within and outside of the allied social sciences:

- CommuterLINK Feasibility Study (Political Science and Geography)
- Upper Midwest Freight Corridor (Geography, Business, Civil Engineering)

- Great Lakes Maritime Information Clearinghouse (Geography, Business)
- USACE Master Docks Plus Database Development (Geography, Army Corps of Engineers)
- USACE Rate Studies (Geography, COB, Army Corps of Engineers)
- Great Lakes Ports Economic Impact Study (Geography, GLMRI, U. Minnesota Duluth)

An important outgrowth of the research accomplishments of Social Science faculty was the next step toward a formal advanced graduate degree program in Spatially Integrated Social Science (SISS). The allied social science departments argued effectively in 2002 that the success achieved in the social sciences not only merit investment in the research infrastructure, but also in the addition of faculty with research backgrounds that combine GIS and spatial analysis with additional substantive expertise in a wide range of areas—including transportation. The allied social science departments argued further that the formation of a Ph.D. program would solidify this research focus by attracting talented faculty and graduate students to the university. Faculty expertise in the social sciences that can make effective use of spatial data and spatial analytic tools will not only complement all aspects of the GISAG effort, but also strengthens the university's role in research and outreach in a wide variety of problems. This includes projects in transportation. GIS databases represent an important resource in support of social science research that requires specialized analytical expertise regarding quantitative spatial methods of analysis in the various social science disciplines. Additional faculty expertise will significantly contribute to the analysis of the rich data resources being acquired and developed by the GISAG as well as interpretation of research outcomes in dealing with the implications of the economic, social, political and cultural elements of the transportation landscape from the local to the global scale.

Project Objectives

The objectives for the SISS Transportation research agenda and curriculum are best described as a listing of topics that will be supported and explored within the program. Each of these topics listed below represents the convergence of nearly all of the disciplines that comprise the SISS program and their contribution to transportation research. In many cases, seminars devoted to specific topics listed below will be developed and offered in the program (e.g., SISS 8185: Seminar in Advanced Topics). In other cases, the topics will comprise a portion of existing course content within each of the four departments in the program (most notably SISS 8190: Spatial Transport Modeling and Planning). A complete list of courses is listed in the Appendix. Transportation topics to be explored are organized as follows but not necessarily limited to this list:

Transportation and urban form

The relationship between transport and land use
The effects of the built environment on travel behavior

Transportation, Public Administration and Policy

Distribution of transportation funding over geographic space
The impact of transportation projects on local and regional economies
Performance Metrics in Promoting Efficiency of the Transportation Infrastructure and Services
Social Justice Issues and Transportation Infrastructure Funding and Policy
Transportation and national security
Transportation and Economic Development

Transportation Analysis and Quantitative Methods

Goods movement and Logistics—the role of transportation in the supply chain
Optimization Theory, Modeling and Freight Planning
Modeling and simulation of traffic flows
Network Analysis and Graph Theory

Travel Behavior, Spatial Cognition, and decision-making
Geographic Information Systems as a means to integrate multiple elements of the transportation
Transportation and Facility Location

Intermodal Transportation—Passenger and Freight

Public Transit: planning, management
Transit Facility Siting and Planning
Intermodal Infrastructure Planning
Rail Transportation—Freight and Passenger
Highway Transportation
Air Transportation—Freight and Passenger
Water Transportation—Inland Waterway and Maritime

Infrastructure Utilization and Planning

Performance Metrics in Promoting Efficiency of the Transportation Infrastructure and Services
ITS—Intelligent Transportation Systems
Urban Transportation Planning
Safety

Transportation and the Environment

Emissions
Noise
Transportation and the Spatial Dimensions of Alternative Energy

Advancing the UT-UTC theme and the Research Contribution of the Project

The increasingly complex world of the twenty-first century will demand more sophisticated approaches for solving problems. The program presented here presents a curricular and research focus that will produce a new generation of social scientists with the capability to combine a clear understanding of the underlying theory of their chosen discipline with the technical expertise to assemble and manage data from a diverse array of sources and apply sophisticated analysis techniques that will provide a new perspective for decision-making in either the private sector or public policy arena. Graduates of this program will certainly have the ability to perform advanced geospatial transportation-related research in social science, but we also anticipate that our graduates will serve as a vital link between GI Science technology and the demands of society's decision makers and stakeholders. We expect our graduates to be competitive for positions of leadership in government positions ranging from the national to the local level. We also envision our graduates to be sought for positions in the private sector and consulting organizations. As the structure of higher education changes over the next several years and decades, we also anticipate that our new generation of scholars will arrive in new multidisciplinary academic programs that demand the capability to merge a strong grasp of theory with the technological and analytical competence to address the problems of a rapidly-changing world.

The particular transportation-related areas of interest the SISS program offers that complement the UT UTC are in the areas of *Addressing the Changing Transportation Needs of the 21st Century (passenger and freight), Transportation and Regional Economic Development, Infrastructure Utilization,* and *the spatial dimensions of Supply Chains*. Each of these topics readily lends themselves to the faculty expertise, the available geospatial technology, and the regional economic needs of northwest Ohio. Furthermore, the SISS faculty will focus on the movement of people among all modes of the transportation system and in the conflicts that arise between the movement of freight and the movement of passengers.

The spatial dimensions of supply chains is of particular interest in terms of the location and direction of distribution systems within the transportation network. Not only does this require sophisticated modeling and analysis on networks, but also in location analysis for facilities that range from manufacturing plants to transshipment points, to warehouses, and ultimately to retail and other distribution outlets. Strategies to optimize the flow of goods between each of these inputs are essential if the national and regional economies are expected to grow. To quote the UT UTC Request for Proposals, "Understanding the role of transportation in this new paradigm and adapting the transportation systems to meet those needs for suppliers, manufacturers, and customers is fundamentally important for economic growth and development." (UT UTC, 2007, p.3). The RFP goes on to state the following which further underscores the need for geospatial information processing technologies and sophisticated spatial-analytic capabilities:

> By 2020, the amount of freight moving across the various modes of transportation is expected to increase by 80 percent. A comparable increase in transportation infrastructure is not a viable option because it is capital-intensive and requires the commitment of valuable land that could be used for agriculture, recreation, and economic development. To respond effectively, ideas and methods are needed that (1) increase the utilization of existing assets through the application of information technology and innovative management practices and (2) identify innovative solutions to bottlenecks in the transportation system. Through information gathering, data mining, analysis, and assessment, it is possible to improve the management and planning that lead to increased infrastructure utilization and availability…New computerized systems and algorithms allow very large datasets to be collected and analyzed to recognize current and anticipate problems in the transportation system. Integration of information technology and transportation asset management will generate new research opportunities and lead to the creation of curriculum and educational programs that emphasize these ideas (UT UTC, 2007, p.4).

Infrastructure utilization and *Transportation and Regional Economic Development* are also important areas for research with in the SISS Program, as they are directly linked to geography, urban planning, political science, public administration and economics. The importance of space in both of these areas cannot be overemphasized, particularly with respect to how they relate to a wide range of social processes that include but are not limited to employment, public safety, public policy and the environment. The urban transportation planning core area of the Planning Program will play a major role in shaping the SISS involvement with the UTC.

Implementation of the Education Component

The following discussion outlines how the program has been implemented, how transportation topics fit within the overall scope of the program, and which academic units, research centers and sponsoring agencies are designed to contribute to the program.

Partners and Cooperative Features. The following Social Science academic departments currently contribute to the program:

1. Economics
2. Geography and Planning
3. Political Science and Public Administration
4. Sociology and Anthropology.

The program is officially administered within the Department of Geography and Planning, but will draw from the faculty expertise in all four departments. The participating core faculty in this program are listed in Table 1. The research arms of the program include GEPL's Center for Geographic Information Science and Applied Geographics (GISAG), and the newly proposed Center for Applied Policy Research, housed in the Department of Political Science and Public Administration.

Participating Core Faculty	Degree	Research Expertise
Olugbenga O. Ajilore. Associate Professor Department of Economics	Ph.D., Economics, Claremont Graduate University	Public Economics Public Policy Education Finance
Bhuiyan M. Alam Assistant Professor Department of Geography and Planning	PhD., Urban Planning, Florida State University	GIS, Transportation Planning, Environmental Planning, Urban & Regional Planning, Regional Development
Dr. Lynn Bachelor Associate Professor Department of Political Science and Public Administration	Ph.D., Political Science The University of Chicago	Community Development, Community Performance Indicators
Dr. Julian Brash Assistant Professor Department of Sociology and Anthropology	Ph.D., Anthropology The City University of New York	Urban Anthropology, Urban Planning
Dr. Kevin Czajkowski Associate Professor Department of Geography and Planning	Ph.D., 1995, Atmospheric Sciences University of Michigan	Remote Sensing, Meteorology, Environment, Physical Geography
Dr. Daniel J. Hammel Associate Professor Department of Geography and Planning	Ph.D., 1994, Geography University of Minnesota	Urban Geography, Urban Planning, Housing, Neighborhood Revitalization, Redevelopment
Dr. Patrick Lawrence Associate Professor Department of Geography and Planning	Ph.D., 1996, Geography University of Waterloo	Environmental Management, Environmental Planning, Great Lakes
Dr. Peter S. Lindquist, Program Director Associate Professor and Chair Department of Geography and Planning	Ph.D., 1988, Geography University of Wisconsin-Milwaukee	Digital Cartography, GI Science, GI Systems, Transportation, Location Analysis
Dr. David J. Nemeth Professor Department of Geography and Planning	Ph.D., 1984, Geography University of California, Los Angeles	Cultural Geography, Natural Resources and Environment
Dr. Rubin Patterson Associate Professor Department of Sociology and Anthropology	Ph.D., Sociology Howard University	Science and Technology in the Global South, Technology and Social Change, Information Society
Dr. Neil Reid Associate Professor Department of Geography and Planning	Ph.D., 1991, Geography Arizona State University	Economic Geography, Regional Science, Economic Development, Foreign Investment
Dr. Oleg Smirnov Assistant Professor Department of Economics	Ph.D., 1998, Resource Economics West Virginia University	Spatial Econometrics Regional Economics

TABLE 1. Faculty Participating in the Ph.D. Program Development

The GISAG Center provides a clearinghouse for GIS research opportunities, and provides sources of expertise to enhance student learning at all levels and across a wide range of academic disciplines. The GISAG Center offers GIS graduate certification programs, provides geospatial databases to campus users, and administers system-wide GIS software licenses. In addition, the Center seeks to solve complex problems related to regional, metropolitan and local community issues, including: environmental protection, land use planning, economic development, site characterization, resource mapping and GIS support. Research productivity by GEPL faculty over the past four years reached record levels and is summarized as follows:

- $16 million in external funding since 2001;
- 30+ refereed publications and book chapters;
- 75+ conference presentations; and
- an average of 10+ externally funded graduate students yearly, which exceeds the department's allocation of teaching assistants funded annually.

In sum, it is expected that transportation and all of its spatial dimensions will play a pivotal role in the Spatially Integrated Social Science Ph.D. Program at The University of Toledo. This unique multidisciplinary program is designed to attract students with an interest in examining social processes such as transportation from a highly analytical perspective, but with an appreciation of the contribution of diverse social science disciplines for understanding these processes.

Methodology and Plan Components. The Ph.D. program is structured to provide a focused curriculum of instruction, training, and research that concentrates on location as the key unifying element between our allied disciplines in the study of social, political and economic processes in the landscape. It is envisioned that the new Ph.D. program must therefore initially provide students with a set of core courses and electives that convey the principles of spatial thinking as advocated in the CSISS Initiative.

Students are expected to come into the program with a Master's Degree from one of the allied disciplines including Economics, Geography, Sociology, Political Science, or Anthropology. To assure their success in our program, student admission decisions will be guided on the basis of their performance in their respective graduate programs, their quantitative skills, interest in spatial statistics and geographic information science, and evaluations from referees. It is expected that most students from non-geographic disciplines will lack the necessary background for introducing the principles outlined above and will therefore require remedial training as part of their coursework prior to enrollment in the program's core curriculum.

At the University of Toledo, the Ph.D. program requires 90 semester credit hours beyond the Bachelor's Degree, typically 45 hours of coursework and 45 hours of dissertation. Because we will require that admitted students will already have completed a Master's Degree, this program will need 60 credits. Each student will be required to complete 36 course credits and 24 dissertation credits. Of the course credits, the following requirements have been established:

1. Six mandatory core courses to be taken by all students in the program (18 credit hours).
2. Three advanced seminar courses (9 additional credit hours)
3. A remaining set of 3 elective courses (9 credit hours) to be taken from one of the four allied departments to reach a total of 36 minimum credit hours. It is from these courses that students will be expected to gain their substantive knowledge and expertise in transportation.
4. The student's education is then completed with a minimum of 24 credit hours of dissertation.

A complete list of courses is provided in the Appendix. The College of Arts and Sciences administers the program under the combined leadership of a Program Director and Advisory Committee made up of participating social science faculty within the four allied departments. Admission requirements for this program are the same as those of other Ph.D. programs at the University of Toledo. The Director and Advisory Committee review all applications and recommends admission for qualified candidates.

Conclusion

The Ph.D. Program was officially approved by The University of Toledo and the Ohio Board of Regents in 2008, with Chancellor Fingerhut's final approval given in September, 2008. Recruitment and admission of students for the first class took place during the 2008-2009 Academic Year. The first class began taking classes in August, 2009. Completed dissertations and related published work is anticipated for Spring, 2013, as students complete their seminars and research. The SISS Program web page will display transportation related courses and research topics as a result of our efforts to create a transportation emphasis in the program.

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Appendix

October 23, 2008

The Core Courses *(6)*

SISS 7010: SPATIAL STATISTICS (ALAM)

[3 hours] The course deals with statistical theory and state-of-the-art applied statistical techniques for spatial data analysis. The range of topics include descriptive statistics, statistical modeling and hypothesis testing in the presence of spatial dependence and spatial heterogeneity. Emphasis is made on geospatial statistics, local statistics and spatial diagnostics for spatial patterns.

SISS 7020: GEOGRAPHICAL INFORMATION SCIENCE IN SISS (LINDQUIST/CZAJKOWSKI)

[3 hours] The course covers in detail the underlying theory and assumptions associated with GIS and remote sensing. The course emphasizes the fundamental elements of cartography, geodesy, statistics, mathematics and geo-computational methods that form the foundation for the development of GIS and spatial analysis tools. Additional topics include spatial databases architectures, algorithms, and applications. Exploratory spatial data analysis. Visualization of spatial data. Spatial database cyber-infrastructure.

SISS 8010: FOUNDATTIONS OF SPATIALLY INTEGRATED SOCIAL SCIENCE (SISS) (NEMETH/BRASH)

[4 hours] This is an introductory course to spatial analysis for social scientists. The course will examine the historical development of the social sciences, their philosophical and methodological approaches to research, and the emergence of the spatial perspective in social science research The course focuses on (1) the conceptualization and formalization of space and spatial relations, with exploration of characteristics of spatial data, effects of spatial proximity and distance, and topological characteristics of space, (2) the study of spatial processes: discrete and continuous, volitional and natural, stochastic and deterministic, and (3) an analytical treatment of spatial patterns related to social processes with examination of spatial dependence, heterogeneity, spatial clusters. Other approaches include graph theoretical representation of space, spatial networks, and spatial hierarchies.
This course replaces all of the Spatial Analysis seminar courses that were to be offered within individual departments—SISS 8110-8140)

SISS 8020: SISS THEORY (SMIRNOV/HAMMEL)

[3 hours] This course prepares students to carry out advanced work requiring preparedness in theoretical and methodological aspects of spatial analysis in social sciences. The course concentrates on (1) the spatial organization of society and (2) spatial human and social dynamics. The topics includes spatial interactions and social institutions, spatial random utility theory, spatial economic growth and convergence, spatial stratification, income inequality, segregation among others.

SISS 8030: ADVANCED SPATIAL DATA ANALYSIS (SMIRNOV)

[3 hours] The course covers models of spatial processes: spatial autoregressive models, gaussian Markov random field models, auto-logistic models, spatial discrete choice models. The topics include spatial panel data models and their applications and estimation methods: generalized method of moments, likelihood-based, and minimum distance; spatial sampling. Applications to a broad range of social science problems.

SISS 8040: RESEARCH DESIGN (COORDINATOR: TBA)

[2 hours] The course introduces students to research and research technicalities: what is research, how to write research papers and research proposals, how to design and manage research project, etc. To help students make a transition from course work to research, the course requires to complete a short communication (2,000 words), which will grow into a research paper of 'publishable' quality students must write during the third year.

The Advanced Seminar Courses

SISS 7030: GEO-COMPUTATION (LINDQUIST)
[3 hours] Advanced follow-up to SISS 7020. Computational foundations of spatial analysis. Elements of computational geometry, finite mathematics, surface modeling and computation of continuous phenomena. Specialized numerical analysis of spatial data within a GIS environment. Requires programming expertise.

SISS 8150: ADVANCED QUALITATIVE ANALYSIS IN SISS (BRASH, TBA)
[3 hours] Advanced qualitative analysis techniques and applications to a broad range of spatially oriented social science problems.

SISS 8160: POLICY EVALUATION AND SISS (BACHELOR, AJILORE)
[3 hours] Examination of the role of space, place and location in the analysis of public policy, with particular emphasis on spatial approaches to needs analysis and policy and program evaluation. The seminar will provide a detailed review of policy analysis an devaluation techniques and literature. Students will complete an original research paper utilizing spatial analysis in the evaluation of a policy or a program.

SISS 8165: ADVANCED MODELING METHODS AND TECHNIQUES IN SISS (LINDQUIST)
[3 hours] Advanced spatial modeling techniques for social scientists including a detailed examination of the role of systems theory and operations research in SISS. The integration of models within GIS and remote sensing systems will be included along with a detailed review of the literature and preparation of papers for presentation. Advanced follow-up to SISS 7010 and SISS 8030; The basic idea of Methods Group trio:

SISS 7010 Advanced Spatial Statistics (Method I),
SISS 8030 Advanced Spatial Data Analysis (Method II),
SISS 8165 Advanced Spatial Modeling Methods and Techniques (Methods III)

SISS 8170: SPACE AND SOCIETY: CRITICAL THEORY IN SISS (BRASH, HAMMEL)
[3 hours] Critical examination of both the role of spatial inquiry and its limitations to the understanding of society and space. Major components of the seminar will deal with a detailed review of the literature and preparation of papers for presentation.

SISS 8175: SPATIAL PERSPECTIVES ON THE ENVIRONMENT (LAWRENCE, EGAN)
[3 hours] Examination of the relationship between SISS approaches and human interaction with the natural environment. Significant attention devoted to the applications of GIS and remote sensing to the study of human-environmental interactions. Major components of the seminar will deal with a detailed review of the literature and preparation of papers for presentation.

SISS 8185: SEMINAR IN ADVANCED TOPICS (TBA)
[3 hours] Readings and discussion of the primary research literature in a selected topic or set of topics in Spatially Integrated Social Science.

SISS 8180: DISCRETE CHOICE SPATIAL PROCESS MODELING (SMIRNOV)
[3 hours] A specialized follow-up to SISS 8010 and SISS 8020. Focuses on the study of the human factor in spatial processes. The main goal is to advance understanding of spatial aspects of human factor and social dynamics by modeling discrete choice spatial processes. The course covers issues of model design, estimation methods, applied model development, and analytical techniques for the analysis of spatial phenomena.

SISS 8190: SPATIAL TRANSPORT MODELING AND PLANNING (ALAM,LINDQUIST)
[3 hours] A specialized course dealing with the modeling and simulation of transportation systems and planning for future transportation facilities.