Ph.D. General Exam Proposal

Massachusetts Institute of Technology
Department of Urban Studies and Planning

Basic Information

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Fields of Examination

Field 1: Urban Information Systems
Field 2: Spatial Inequality and Uneven Development

Written Examination

Proposed Dates: TBD
Number of Questions (asked/answered): Field 1 – 3/2; Field 2 – 3/2
Parameters: Font: minimum 12 point; Length (per question): maximum 8-10 pages; Line spacing: minimum 1.5; Margins: minimum 1 inch.

Oral Examination

Proposed Date: TBD

Examination Committee

Chair: Joseph Ferreira Jr., Professor of Urban Planning and Operations Research

Signature:

Member: Amy Glasmeier, Professor of Geography and Regional Planning

Signature:

Member: Jinhua Zhao, Assistant Professor of Urban Planning

Signature:

Submission Date:

Introduction

For my general examinations I have chosen Urban Information Systems (UIS) as the intellectual approach and Spatial Inequality with a special emphasis on Economic Geography as the applied field.

I have chosen this combination based on my interest in the connection between spatial analysis and wealth distribution at the local level. My particular interest is in the *processes* and *patterns* of wealth creation and distribution within cities. For instance, imagine that a given process is creating economic segregation in Boston. I, as a researcher, use analytics to detect and measure such a spatial pattern of segregation. However, the questions are twofold: how can I explain the process generating such spatial pattern? And, how does the process function in order to create the pattern that I see?

The concepts of p*rocess* and *pattern* are theoretical foundations of spatial analysis. Urban Information Systems (UIS) offer a number of tools to detect and predict spatial patterns. UIS has also extensively modeled and hypothesized about generator mechanisms of spatial patterns in land use, mobility, and real estate. Nonetheless, not much research has been done on the processes behind the creation and distribution of wealth at the scale of cities. Batty, O'Sullivan, and Haining have theorized about the processes behind spatial patterns. For Haining, there are four types of processes behind any type of pattern: *diffusion*, *exchange and transfer*, *interaction*, and *dispersal*. Batty, for his part, has attempted to explain the patterns of sprawl and public services' scaling. He attributes this to economies of scale and agglomeration economies.

On the side of economic geography, the discipline has a longstanding tradition of theorizing about the processes that lead to wealth spatial inequality, including factors such as spatial division of labor and prevailing power structures. However, Economic Geography comes up short in predicting the spatial patterns that are derived from its premises. The theoretical disconnection between *social processes* and *spatial patterns* is not trivial because a single process can produce more than a pattern, and, that same pattern might be reproduced by more than a process. There is a missing connection

between the work of Haining and Batty with the tradition of Human Geography, although, authors like Anselin, Goodschild, Johnston, and Po Kwan have made contributions to start filling in those gaps. My research interest is to contribute to such discussion in the future and, the general exams represent a first step in that direction.

First Field – Urban Information Systems

Urban Information Systems (UIS) is a multidisciplinary field that draws from geographic information science, computer science, operations research, statistics, economics, and cognitive science, where information technology is the pivotal element linking such diverse fields. In applying the particular knowledge and theories of each of those sciences to cities, UIS analyses the impact of information and communication technologies on urban planning in the following three ways. First, information technology works as a problem solving toolkit for urban planners. Technology and novel analytical methods aid in the development of new solutions to old problems, such as traffic congestion or participatory planning. Second, information technology opens up new research venues in which dynamics related to human activity and mobility can now be explored thanks to new available data and new methods. The massive volumes of collected geospatial data offer an opportunity to better understand how cities organize over time. Finally, UIS seeks to analyze the impact of information technologies on cities, through physical space, people and institutions. Pervasive computing, mobile devices, and sensors are transforming both the way cities are used, and the way they generate and distribute wealth. The exam field is divided into four distinct domains, which reflect the broader areas previously described: 1) Geospatial Information Analysis and Management; 2) Information Technology Communication and Representation; 3) Urban Analytics Models; and, 4) Social Implications of Geographic Information Technology.

1. Geospatial Information Analysis and Management

This domain is concerned with investigating patterns that arise as a result of certain processes that may be operating in space (Sullivan & Unwin, 2010). An alleged

connection between generator processes and spatial patterns lays out the theoretical foundation for this field. Techniques and methods to enable the representation, description, measurement, comparison, and generation of spatial patterns are central to the study of geospatial information analysis. These techniques consist of spatial data manipulation, spatial data analysis, spatial statistical analysis, and spatial modeling. Two relevant tools of spatial analysis are Geographic Information Systems (GIS) and Relational Databases, which in turn might be applied to support planning functions.

1.1 Geographic Information Systems (GIS), Geospatial Services, and Representation

This section covers crucial concepts of spatial analysis such as spatial dependency and heterogeneity. Generic spatial processes operate in geographic space generating data, where, spatial structure emerges as a fundamental property of the data, manifesting itself either as a dependency or autocorrelation (Haining, 2003).

GIS has embedded functions to detect and predict both spatial dependence and autocorrelation at different scales. Examples of these functions are interpolation, k-nearest neighbor, and surface analysis among others. However, GIS shortfalls in handling temporal data, which is a drawback for urban planners who rely on past observations to forecast future outcomes. To overcome this problem, more advanced techniques of spatial analysis have been developed outside of the GIS environment, such as neural network modeling, discrete choice modeling, cellular automata and agent based modeling. Furthermore, these tools can be coupled to work with GIS software. A degree of coupling between both software tools is desirable in order to take advantage of GIS' embedded functions and visualization capabilities. Each degree of coupling represents a tradeoff between the number of lines of code written and data manipulation. Accordingly, the impact of these tradeoffs, as measured in time and effort, must be taken into account when considering any coupling efforts.

1.2 Database Design and Management

Databases have helped planners to accumulate information and knowledge in an efficient way. Database systems are particularly useful to organize complex and large datasets, and to retrieve on-demand information. A good database design reduces data inconsistencies, shrinks storage space, facilitates collaboration among users, protects privacy, and allows scalability. This section covers database designs and issues, including database models, relational algebra, database normalization, and SQL language. Applications of databases for spatial data can be found in the previous section in De Smith, Michael John, Michael F. Goodchild, and Paul Longley, 2013, and Wilson, John P., and A. Stewart Fotheringham, 2008.

1.3 Information Technology and Planning Support Systems

This section engages the use of support capabilities incorporating GIS and analytic models to encourage rational planning in the decision process (top-down planning). The two pieces by Hopkins are fundamental to connect planning theory with the importance of forecasting urban outcomes; transparent and accurate predictions are the necessary input to make educated guesses about future urban outcomes. However, modeling and forecasting can seldom be simultaneously transparent and accurate which creates a problem. Planning support systems always face a certain tension between openness and precision. The most transparent systems are the most effective in communicating results, but their predictions often lacking in terms of realism and accuracy. In contrast, the most precise systems are black boxes, so to speak, that frequently fail to gain the trust of planners and stakeholders. The best of both worlds does not fit into one single tool.

2. Information Technology Communication and Representation

This domain encompasses the impact of Information Technology (IT) on the urban space. Mobile devices and pervasive computing are changing not only people's consumption and mobility; but also the forms of human interaction with the physical space and with other individuals. Newly available data from web scrapping and mobile devices is ready to be used to shed light on social dynamics. As more far-reaching and real-time data becomes available, effective visualizations are essential to conduct exploratory analysis and communicate results.

2.1 Digital Cities

The rapid expansion of IT over broad areas of the economy has engendered the anticipation that jobs would decentralize across geographies. And, that virtual interactions were displacing face-to-face communications and cities as economic forces would no longer be necessary. However, the opposite has happened: cities have thrived and they are the key players in today´s global economy. As a result, a complex urban pattern has emerged, where certain type of jobs are highly centralized (e.g. finance, technology), while others have spread out (e.g. manufacturing, insurance). IT is what enabled the development of such a complex pattern of economic production, although IT is itself part of a more far-reaching change in the economic system where capital has overridden labor (Castells, 1989).

2.2 Web Mining, Mobile Data, and Human Interaction

Mobile devises, social media and search engines represent rich sources of data to explore social dynamics. Web scrapping is a tool to extract data from the web, which is used to build databases from the vast amounts of information available in the web. Then, statistics and data mining can work on those databases to approximate unobserved variables, to classify observations, or to detect patterns, in order to better understand urban dynamics like mobility and interaction.

2.3 Visualization

This section covers the work of Mark S. Monmonier and Edward R. Tufte, classics in the visual display of quantitative data. As geo-spatial data becomes increasingly available, creative visualizations are needed for two purposes. The first one is to conduct exploratory analysis of complex datasets. The second one is to effectively communicate results to our audience.

3. Urban Analytics and Models

This domain engages the methodologies that planners use to explore, model, calibrate, and predict urban outcomes, such as land use, transportation capacity, land values, and sprawl, among others. Urban economics and statistics are the two foundational pillars of urban modeling. The combination of theory with a variety of statistical methods have helped to understand the causes of urban outcomes, and to predict them throughout large-scale models.

3.1 Economic Theory

This section covers the urban economic models of land rent, transportation and population growth. The classic monocentric model (Alonso, 1964) is the starting point to delve into this literature. The Alonso model specifies that cost of land and population density, both decay as distance from Central Business District (CBD) and transportation cost increase. Variations to the monocentric model, where certain assumptions are relaxed, have been developed to investigate for example polycentricity, land use, congestion cost, and housing supply.

3.2 Analytical Methods: Statistics, Probability, Spatial Measurement, and Analysis

Analytical Methods embody the foundations for spatial analysis. They are the tools needed to detect, model and predict spatial dependencies and heterogeneities. These tools run the show behind the scenes for large-scale

urban models and planning support systems. This section addresses a wide spectrum of techniques, ranging from the workhorse regression to data mining. Locational analysis, agent-based models and networks are also covered.

3.3 Large-Scale Urban Models

From a set of hypothesized processes, large-scale urban models rely on analytics and theory to simulate spatial urban patterns. The granularity of the models ranges from individuals to areal units of different levels of aggregation, depending on the methods and data used. UrbanSim is amongst the more sophisticated models, being able to make predictions on land markets and travel behavior from individual level simulations. Likewise, the *New Science of Cities* by Batty is an overarching effort to understand urban outcomes (e.g. land use) as consequences of simple bottom-up processes that lead to complex emergent behaviors.

4. Social Implications of Geographic Information Technology

This domain captures the social implications of GIS (IT broadly speaking) on democratic decision making and institutional change. On the one hand, IT and GIS support a prevailing top-down type of planning, which is fed by skilled experts analyzing data and making one-sided decisions. On the other hand, GIS technology empowers bottom-up planning, where actors who would otherwise remain excluded from decisions now actively participate in the planning process. Remarkably, in the bottom up approach, GIS plays a fundamental role making decisions to be informed and sustained on data.

4.1 Public Participation GIS and the Epistemology of GIS Practice

GIS is a tool for both good and for bad. On the one side maps can be instruments of power and manipulation. Spatial analysis frequently reflects existing power structures; access to knowledge is unbalanced, benefiting large

organizations and the wealthiest. On the other hand, GIS offers a voice to the marginalized and enables communities to make better decisions by providing access to more information. The current section reviews the underlying tension between the two positions and offers a number of cases where public participatory GIS has been successfully implemented for urban planning.

4.2 Organizational and Institutional Implication of Information Technology

This section addresses the institutional environment of planning, with the aim of developing a broad understanding of the organizations and planning processes within which information technologies are brought to bear. This body of literature centers on organizational and institutional implications of information technology in planning, discussing how UIS practices are implemented, whether UIS is adopted by the community, and what social changes are possible because of UIS.

Second Field – Spatial Inequality and Uneven Development

Economic growth and wealth are not evenly distributed across space. They are largely confined to specific areas. Economic activity clusters together, and such clustering can be found at different scales and levels of aggregation, extending from blocks to countries. The question that arises is why such clustering occurs. A potential explanation is that places do not have the same endowment of natural resources, which leads regions to specialize in activities where they hold a comparative advantage. The unequal distribution of raw materials locks in an uneven distribution of wealth. However, this theory fails to account for cases where clustering emerged in areas with different natural endowments, and it also fails to explain the concentration of wealth at finer geographical scales than regions.

Another hypothesis is that not only raw materials unevenly distribute, but also labor and capital endowments geographically diverge across space. Labor, especially high skilled labor, tend to concentrate in cities, particularly around a number of clusters of innovation at specific times, such as Detroit or Los Angeles decades ago, or Silicon Valley and Route 128 nowadays. This theory explains the development and maturation of clusters, and of cities, once they exist, but it fails to explain the emergence of centers of innovation at the first instance.

A different explanation that combines classic elements from economic geography and from neoclassical economics argue that centripetal and centrifugal forces are behind the spatial patterns of economic activity and wealth concentration. Those two dynamic forces operate in opposite directions, shaping continuously the space at different scales. Agglomeration economies and economies of scale are the centripetal forces at work that glue activity and agents together. Economic agents benefit by producing larger quantities of goods and by locating geographically nearby other similar agents. However, agglomeration and scale economies would predict the concentration of economic activity exclusively around a single cluster. In reality, we see many urban

centers and/or clusters of innovation because of a counteracting centripetal force that disperses activity. Congestion, housing prices, crime and pollution are examples of centripetal forces. Explaining how these forces operate and counteract is a hot topic of research, and there is not much written on the mechanics of such processes or evidence besides the theoretical formulation. The picture becomes even more complex when places interact through trade, flows of people, capital and information. Some places benefit more than others; core-periphery type of relations develop over time. Interactions also work at different geographic scales, from regions to cities and neighborhoods, influencing the geographic pattern of wealth creation and dispersal.

Besides the uneven distribution of economic activity, another source of spatial inequality is the political economy of place, which is embedded into the economic system. Once wealth is created, political factors determine wealth distribution across space. Power structures and political coalitions leave a footprint on places; welfare states stamp their mark on space and on the flows of goods and people by redistributing benefits though public institutions.

My proposed second field, Spatial Inequality and Uneven Development, builds upon the intellectual framework of the first field to investigate the processes leading to spatial patterns of wealth and poverty distribution. In this exam field, I outline a theoretical framework that connects conceptual threads from economic geography, new economic geography, and political economy of place to attempt explaining the spatial patterns of inequity and uneven development.

The literature in the second field is summarized into four areas of inquiry: 1) Spatial Distinction; 2) Economic Geography; 3) Production and Factors of the Spatial Economy; and 4) Political Economy of Uneven Development.

1. Spatial Distinction

This domain could be summarized as *space matters in social science.* Social phenomena varie across temporal and spatial scales, displaying spatial heterogeneity

and interdependencies. This area divides into two: 1) the foundations of socio-spatial thinking; 2) The implications of scale for social science.

1.1 Space-Time Geographies

This section examines the assumptions about space, place and time from two perspectives. The first one is from the nature of spatial data; the second one from an epistemological standpoint. The nature of spatial data consists of spatial heterogeneity and spatial autocorrelation. A current debate is how a temporal dimension fits into spatial data. From an epistemological angle, space is important because 1) is the product of interrelations, 2) allows for a plurality and the coexistence of distinct trajectories, and 3) is always under construction. The two perspectives presented here jointly theorize about a conception of space anchored in geo-spatial data.

1.2 Sociology of Space and Scale

Scale is a geographical concept that enables us to talk about spatially uneven development and to define certain processes as global or local. There is no clear agreement whether scales are real things, materially manifested in the landscape, or whether they are mental artifacts to make sense of the world. The conception of scale is the theoretical artifact that allows us to define places as exclusionary (e.g. scale as concentric circles), inclusionary (e.g. scale as a Matryoshka doll) or integrative (e.g. scale as networks and flows). Moreover, processes can be scale invariant, or they might differently manifest at distinct scales.

2. Economic Geography

Economic Geography attempts to explain the manifestation of economic processes across territories at various scales: local, regional, national, and global. Throughout history, economic geographers have hypothesized about a number of drivers of territorial development, highlighting on economies of scale and agglomeration during the last two decades. This section reports the evolution of the discipline after World

War II, starting with the so-called quantitative revolution, addressing by the modern school, and laying out some new directions. The quantitative revolution was the first effort to use scientific analysis to develop generalized theories (e.g. Central Place Theory, Monocentric City) to explain geographical phenomena. After the 1970s, economic geography engaged with newly emerging branches of other fields and became a more heterodox discipline, covering topics like poverty, organizational aspects of production, innovation, regulation theory, and cultural geography, among others. Then, during the 1990s, the "New Economic Geography" broke ground through general equilibrium models of spatial competition, integrating a number of previous theories developed in geography and economics. Today, the persistent permeable character of the discipline is endorsed by the continuous new applications developed from theories originated in other fields.

2.1 Quantitative Revolution

During the 1950s and 1960s, the discipline transitioned from descriptive economic geography into a science of spatial systems. The goal was not just to describe those systems and their operations, but also to analyze them with math and statistics, creating models and hypotheses, to produce theories about the spatial organization of society rather than just specific knowledge about individual places. Regional Science, Central Place Theory, and Location-Allocation models to find optimum locations for facilities and efficient flows between them are amongst the most important legacies from this classic school of thought. The literature from this section covers the classic names of the quantitative revolution: Brian Berry, Leslie Currie, William Garrison, Torsten Hagerstrand, Peter Hagett, Walter Isard, and Fred Schaefer.

2.2 Modern Economic Geography

The main critique of the quantitative revolution is that patterns of economic production are influenced by contextual effects, local conditions, and luck; models or laws cannot grasp such elements. Location patterns exhibit path dependence: a specific locational decision made in time would have long-term consequences

for economic development. Forecasting the location of economic activity and wealth is not possible under such framework of uncertainty. Another important critique of economic geography was that it most of its analysis was about location theory and geometry, lacking deeper foundations in economic theory.

After the quantitative revolution, Economic Geography took various directions trying to fix the shortcomings of that approach and several new subfields emerged. Fitting those multiple directions into a single definition of the discipline is a real challenge, but Aoyama, Murphy & Hanson (2010) have done a good effort summarizing it: "Modern economic geography study geographically specific factors that shape economic processes and identify key agents (such as firms, labor and the state) and drivers (such as innovation, institutions, entrepreneurship and accessibility) that prompt uneven territorial development and change (such as industrial clusters, regional disparities and core – periphery)". The current section presents a number of compilation books that introduce the foundations about the factors and drivers described by Aoyama et al. These foundations will be needed to fully engaging the discussion that will be presented in section 3 of this proposal.

2.3 New Trends in Economic Geography

This section engages the critique of the so-called "New Economic Geography" embodied by Krugman, Fujita and Garrett. A critique to this school is relevant to this proposal because such body of theory has had a longstanding influence on the study of the spatial economy over the last two decades. This section also introduces some new directions in the discipline, such as cultural economy and evolutionary economic-geographies.

3. Production and Factors of the Spatial Economy

This domain delves into the factors and drivers of economic processes that prompt uneven economic development. Land, capital, labor and technology could be in many ways combined to produce the same good, each one leaving a unique footprint on the space at various scales. This section addresses the spatial configuration of production,

labor and technology, putting special emphasis on industrial production, economies of innovation and cities.

3.1 Spatial Patterns in Production and Pricing

As suggested by the title, this sub-section examines the spatial patterns of production and pricing. Models of spatial price competition attempt to quantify retail price variation in a framework of general equilibrium, by modeling spatial access to consumers and local monopoly power exerted by firms. This section comprises landmark papers focusing on a variety of spatial traits of production, such as agglomeration economies, organizational culture, and trade linkages. A number of classic typologies of centers of production are as well introduced.

3.2 Labor. Uneven Distribution of Wages, Talent and Innovation

The division of labor can be considered from two standpoints: a top-down or a bottom-up. The top-down reflects the contribution of firms to the economy in terms of what they produce. The bottom-up relates to the technical division of labor between different employees in their contribution to the labor process of a given firm. Doreen Massey´s seminal book the *Spatial Divisions of Labor* is a critical work to understand the connections of labor to industrial geography and uneven development. This section also explores the spatiality of two factors of labor production: wages and productivity. Garretsen for example finds evidence of spatial distribution of wages when dropping the real wage equalization assumption from neoclassic economics, while Parks proves the inter-metropolitan wage inequality in local labor markets in the U.S. Regarding productivity, evidence suggest that social capital, number of innovations, and the so-called creative class in metropolitan areas cluster together.

3.3 Socio-Spatial Dimensions of Innovation and Technology Adoption

Organizational cultures, institutional arrangements, and the market itself shape the rate at which new technologies are adopted. Technological change might distort the amalgam of labor, land and capital, which in turn alters the spatial

patterns of wealth and economic production. This section starts with Castells' all-encompassing theory of technological change in the economy, then it introduces various papers that attempt to categorize the socio-spatial dimensions of technological change in UK and the US.

3.4 Cities as Engines of Economic Growth

Cities are economic centers continuously interacting with their counterparts. Cities connect to each other through flows of people, goods and knowledge. These linkages in turn reinforce cities' economic preeminence position, which has an impact on wealth distribution inside metropolitan areas. Globalization has accentuated those linkages. The current section covers the literature of cities as main drivers of the world economy and economic change, while examining the social consequences of such position on the distribution of wealth over the space, especially in the local context.

4. Political Economy of Uneven Development

Political economy examines the relationship between economic and political structures, processes, and outcomes, with an emphasis on who gains and who loses what.
This section addresses the politics of uneven development and its manifestation in the geographical space. The first part engages the connection between political science and geographical political economy to explain the impacts of the politics, power structure, and policy making on the spatial distribution of wealth.

4.1 Politics of Uneven Development

Power is intrinsically spatial because it affects places' social outcomes. Power is divided across jurisdictions such as municipalities and districts. Agents reclaim power to exert it over a given political jurisdiction. Jurisdictions and actors use power to rationally allocate resources in favor of specific constituencies. The current section explores the actors, scales and consequences of political decisions on uneven spatial development.

4.2 Welfare State and Social Exclusion

Public institutions re-distribute resources through the Welfare State, which also leaves a footprint on the geographic pattern of development through changes in the labor market. Traditionally, the Welfare State has been a topic of interest mainly to economists and political scientists, but other disciplines have also made contributions to this field. This section introduces the approach of geographers to welfare. The body of literature on the spatial divisions of welfare analyzes the notion of territorial justice, tracking the local impacts of welfare programs and reforms on the structure of labor, which in turn has an impact on space.

4.3 Spatial Inequity and Poverty Distribution

The body of literature presented in this section stresses the spatial patterns of poverty and inequity, which are artifacts of spatial factors of political economy. This last section covers poverty, justice, spatial equity, immigration, segregation and slums, building upon the previous parts of this proposed second field.

General Exam Course Preparation

First Field – Urban Information Systems

Course	Instructor	Course Name	Grade	Year	Level	Institution
17.800	Yamamoto	Quantitative Research Methods I	A-	2012	G	MIT
11.410	Wheaton	Urban and Regional Economics	B+	2013	G	MIT
11.521	Ferreira	Spatial Database Management and Advanced GIS	A	2013	G	MIT
17.802	Hidalgo	Quantitative Research Methods II	A-	2013	G	MIT
1.002	Kocur	Intro Comp & Engr Prob Solving	A	2013	G	MIT
11.S947	Williams	Visualizing Shenzhen's Social Media to Understand City Dynamics	A	2013	G	MIT
11.903	Ferreira	Supervised Readings on Urban Information Systems	P	2014	G	MIT
90711	Nagin	Empirical Methods for Public Policy	A	2010	G	CMU
90728	Gorr	Introduction to Database Management	B+	2010	G	CMU
90722	Caulkins	Management Science I	A-	2011	G	CMU
90760	Caulkins	Management Science II	A-	2011	G	CMU
	Neil	Large Scale Datasets for Policy Analysis	B-	2011	G	CMU
90834	Kurland	Health Care Geographic Information Systems	A+	2011	G	CMU
90961	Kurland	Independent Study on Geographic Information Systems	A+	2011	G	CMU
95703	Szczypula	Database Management	A	2011	G	CMU
PT601	Ramsey	Topics in GIS and Remote Sensing	A	2011	G	PITT
PT700	Harbert	Advanced Geographic Information Systems	A+	2012	G	PITT

MIT- *Massachusetts Institute of Technology*; CMU – *Carnegie Mellon University*; PITT - *University of Pittsburgh*

Second Field - Socio-Spatial Inequality and Geographies of Uneven Development

Course	Instructor	Course Name	Grade	Year	Level	Institution
11.401	Briggs, Thompson	Introduction to Housing & Community Development	A-	2012	G	MIT
11.410	Wheaton	Urban and Regional Economics	B+	2013	G	MIT
11.469	Briggs	Urban Sociology	A	2013	G	MIT
11.355	Saiz	International Housing Economics and Finance	A	2014	G	MIT
88759	Borzutzky	Globalization	A+	2010	G	CMU
90714	Borzutzky	Policy and Politics in American Institutions	A	2011	G	CMU
	Bassols	Microeconomics I	7	1999	U	ITAM
	Pruneda	Macroeconomics I	10	2000	U	ITAM
	Palacios	Microeconomics II	8	2001	U	ITAM
	Robles	Microeconomics III	7	2002	U	ITAM
	Copelman	Macroeconomics II	7	2003	U	ITAM
	Aguilera	Political Economy I	8	2003	U	ITAM
	Velez	Political Economy II	8	2004	U	ITAM

MIT- *Massachusetts Institute of Technology*; CMU – *Carnegie Mellon University*; ITAM – *Instituto Tecnológico Autónomo de México* (scale of grades from 0 to 10, where 10 is the highest and 0 the lowest)

Methodology

Course	Instructor	Course Name	Grade	Year	Level	Institution
11.233	Carmin	Research Design	A-	2012	G	MIT
11.522	Ferreira	Research Seminar in Urban Information Systems	A-	2012	G	MIT
11.800	Glasmeier, Polenske	Doctoral Research Paper	A-	2013	G	MIT

FIRST FIELD: URBAN INFORMATION SYSTEMS

1. Geospatial Information Analysis and Management

1.1 Geographic Information Systems (GIS), Geospatial Services, and Representation

Books:

De Smith, Michael John, Michael F. Goodchild, and Paul Longley. *Geospatial analysis: a comprehensive guide to principles, techniques and software tools*. Electronic Book, 2013.

DeMers, Michael N. *Fundamentals of geographic information systems*. John Wiley & Sons, 2008.

Haining, Robert P. *Spatial data analysis: theory and practice*. Cambridge University Press, 2003.

Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. *Geographic Information Systems and Science*. John Wiley & Sons, New Jersey, 2011.

Nyerges, Timothy L., and Piotr Jankowski. *Regional and urban GIS: a decision support approach*. Guilford Press, 2012.

O'Sullivan, David, and David John Unwin. *Geographic information analysis*. John Wiley & Sons, New Jersey, 2010.

Shneiderman, Ben. *Designing the user interface: strategies for effective human-computer interaction*. Vol. 2. Reading, MA: Addison-Wesley, 1992.

Wilson, John P., and A. Stewart Fotheringham, eds. *The handbook of geographic information science*. John Wiley & Sons, 2008.

Worboys, Michael F., and Matt Duckham. *GIS: a computing perspective*. CRC press, 2004.

Articles:

Batty, Michael, and Yichun Xie. "Research Article. Modelling inside GIS: Part 1. Model structures, exploratory spatial data analysis and aggregation."*International Journal of Geographical Information Systems* 8, no. 3 (1994): 291-307.

Batty, Michael, and Yichun Xie. "Modelling inside GIS: Part 2. Selecting and calibrating urban models using ARC-INFO." *International Journal of Geographical Information Systems* 8, no. 5 (1994): 451-470.

Brömmelstroet, Marco te, and Luca Bertolini. "Developing land use and transport PSS: meaningful information through a dialogue between modelers and planners." *Transport Policy* 15, no. 4 (2008): 251-259.

Brömmelstroet, Marco te, and Luca Bertolini. "The Role of Transport-Related Models in Urban Planning Practice." *Transport Reviews* 31, no. 2 (2011): 139-143.

Goodchild, Michael F., and Donald G. Janelle. "Toward critical spatial thinking in the social sciences and humanities." *GeoJournal* 75, no. 1 (2010): 3-13.

Haklay, Mordechai. "How good is volunteered geographical information? A comparative study of OpenStreetMap and Ordnance Survey datasets." *Environment and planning. B, Planning & design* 37, no. 4 (2010): 682.

Kwan, Mei-Po, and Tijs Neutens. "Space-time research in GIScience."*International Journal of Geographical Information Science* 28, no. 5 (2014): 851-854.

Nedovic-Budic, Zorica. "Evaluating the effects of GIS technology: review of methods." *Journal of Planning Literature* 13, no. 3 (1999): 284-295.

Onsrud, Harlan J. "Identifying unethical conduct in the use of GIS." *Cartography and Geographic Information Systems* 22, no. 1 (1995): 90-97.

1.2 Database Design and Management

Books:

Casteel, Joan. *Oracle 11G: SQL: SQL*. Cengage Learning, 2009.

Samet, Hanan. *The design and analysis of spatial data structures*. Reading, MA: Addison-Wesley, 1990.

Ullman, Jeffrey D., Hector Garcia-Molina, and Jennifer Widom. *Database systems: the complete book*. Vol. 2. Upper Saddle River: Prentice Hall, 2001.

Articles:

Ferreira Jr, Joseph. "Database management tools for planning." *Journal of the American Planning Association* 56, no. 1 (1990): 78-84.

1.3 Information Technology and Planning Support Systems

Books:

Brail, Richard K. *Planning support systems for cities and regions,* ed. Lincoln Institute of Land Policy, 2008.

Geertman, Stan, Fred Toppen, and John Stillwell, eds. *Planning support systems for sustainable urban development*. Vol. 195. London: Springer, 2013.

Hopkins, Lewis D. *Urban development: The logic of making plans*. Island Press, 2001.

Hopkins, Lewis D., and Marisa Zapata, eds. *Engaging the future: Forecasts, scenarios, plans, and projects*. Lincoln Institute of Land Policy, 2007.

Meyer, Michael D., and Eric J. Miller. *Urban transportation planning: a decision-oriented approach*. McGraw-Hill Science/Engineering/Math, 2001.

Miller, Harvey J., and Shih-Lung Shaw. *Geographic information systems for transportation: principles and applications*. Oxford University Press, 2001.

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SECOND FIELD: SPATIAL INEQUALITY AND UNEVEN DEVELOPMENT

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Sample Questions

Field 1: Urban Information Systems

1. During the fifties and sixties, a generation of scholars extended the limits of spatial analysis beyond the realm of geography. A number of disciplines, ranging from biology to sociology, gradually became interested in analyzing spatial patterns in phenomena of their interest, and urban planning was not an exception. Theories that explain such patterns were developed, and new fields such as regional science emerged. Two decades later, the foundations of spatial analysis were mathematically formalized by scholars such as Anselin and Fortheringham, who also provided a set of statistical tools to detect and model spatial patterns of dependency. This evolution has not been exempted from criticisms; some academics still neglect the contributions of spatial econometrics to statistics. However, the methods are today widely spread and accepted across many fields.
   Currently, scholars like Batty and Haining are digging deeper; they are studying the spatial processes behind the spatial patterns that we see, the same spatial patterns for which Anselin and others have created a number of tools to detect and measure. Today, the problem is not detecting, but understanding the processes behind those patterns, in our case the urban patterns. The question is whether there is a “law” of spatial processes causing any generic spatial pattern, regardless if it is social (e.g. income) or physical (e.g. soil type, ants). Will we someday be able to talk about spatial principles or laws that govern any agent in space? Do you think spatial analysis should be a science of patterns or of processes? Discuss the limitations that both tracks face. Can we talk about urban spatial processes that repeat across cities and scales?

2. Throughout the past fifty years, a number of modelling techniques have been implemented in urban planning with the purpose of creating “better” plans; better in the sense of predictions being more accurate, results being replicable, or the

decision making process becoming more democratic and inclusive. This variety of goals is reflected in the large number of modelling traditions in urban planning. For instance, models might be entirely theoretical, computationally intensive, top-down, bottom-up, large scale, among many other types. Critically evaluate the most important traditions of modelling in urban planning, addressing the tradeoffs of each approach in terms of transparency and efficiency.

3. Imagine that you work as a professor of urban planning at a local university in a developing country. The capital city of this country is growing fast both in population density and in extension because of its thriving economic activity, rural-urban migration and sprawl. The city lacks of a coordinated plan for its future, but there exist some planning efforts dispersed across a number of uncoordinated government agencies. Government officials commission you to develop a proposal of a master plan of the city growth for the next decade; the plan should address transportation and land use. Develop your proposal and specify the role that information technology would play in the plan.

Field 2: Spatial Inequality and Uneven Development

1. Why does economic activity and wealth tend to cluster at specific locations? Critically assess the theories that account for the phenomenon of economic clustering at the global, local and intra urban scales.

2. Technology change and innovation are hot topics in urban studies and economic geography because of their consequences on the labor market and urban form. A number of countries across the world try to build the conditions needed to foster innovation clusters in order to replicate the successful cases of Silicon Valley, Route 128, Manhattan, and London. Currently, a consensus exist in that a large pool of high skilled labor, firms willing to innovate, and an enabling environment of collaboration are necessary inputs for such clusters to emerge. However, the debate is focused on which of those elements should be present first. This discussion is like the chicken-egg problem: should firms or labor arrive

first? For example, Glaeser argues that skilled labor attracts firms, while Storper claims that firms attract skilled workers at first instance. Critically evaluate both schools of thought and discuss their arguments.

3. The book Capital in the Twenty-First Century by Thomas Piketty has caused quite a stir since its release in 2013. Piketty has put in the public agenda, and in the agenda of neoclassical economics, the problem of rising income inequality. However, there are two points that are worth delving here. On the one hand, inequality has since longtime been a relevant topic in disciplines such as urban sociology and geography, much before the relatively recent interest from economists. On the other hand, *spatial* inequality remains out of the agenda of neoclassical economics, even if it is deeply rooted in inequality. The spatial dimension of inequality cannot be obviated. Explain what causes the fields of economic geography and urban planning attribute to rising inequality, and what implications adding a spatial dimension have to the on-going debate.