This course is designed to provide graduate students in the applied social and natural sciences the theoretical and practical skills for conducting research in complex urban settings. The objective is to develop critical and analytical skills for designing and conducting empirical and applied research in urban science. The emphasis is on integration and synthesis of theories, concepts, and data across multiple disciplines. Research design is framed as an emergent process. Students will be exposed to the issues involved in research decisions and to diverse problem-solving strategies, methods, and technical tools. The course examines the logic and limits of scientific inquiry, conceptualization and measurement of social and ecological phenomena in urbanizing systems, and principles of research design and practice.

The course is structured in two components: a theoretical/methodological component and an applied research component. The theoretical component consists of lectures on research design principles and approaches. Lectures cover statistical principles of research design, hypothesis testing and statistical inference, sampling strategies, and analytical approaches to randomized experimental, quasi-experimental, longitudinal, and cross-comparative studies. Major theoretical issues include: threats to internal validity, sampling and external validity, reliability of measures, causality, interpretation of statistical analysis, and ethics in research. The applied research component focuses on emerging problems across Metropolitan Areas. Students will apply their skills on selected themes and work in teams on pilot projects. The class features interactions with diverse urban scientists including invited video lectures of experts of big data on research applications, challenges, and lessons learned through their experience.

Themes of inquiry include: Urban change and evolution, predicting and imagining the future city, urban ecology and climate change, social networks, transportation and virtual mobility, shared economies and innovation, urban analytics, urban sensors, and big data.

**Prerequisites:** Introduction to statistical methods, including the basic idea of random sampling, basic probability laws, regression analysis, and statistical tests.
Course Structure and Assignments

This course is based on lectures and interactive sessions. Students are expected to actively prepare for and participate in the discussions. The interactive sessions are discussions based on selected readings and applied projects and might feature invited video lectures and panels on urban science. We will learn from applied research, the challenges, and lessons learned through experience.

Research Design Paper. Focusing on their individual research topic, students are expected to develop a 15-page research design proposal which will articulate: a research question, testable hypotheses, appropriate research design and methods, and evaluation. To develop the research proposal, students will build on three exercises: 1) frame research question, 2) literature review, and 3) evaluation of alternative research design.

Team Project. The applied research design component will include a pilot application using data on socio-ecological indicators available for US Metropolitan Areas. We will have teams focusing on different questions on key themes of students’ interest and for which data are readily available for the US Metropolitan Areas. Students teams will produce a pilot application and a brief blog report which will describe the main components of the research, data analysis, and findings.

Grading: Class Participation = 20%; Team Pilot Projects = 20%; Final Paper = 50%; Team Presentations = 10%


In addition the course is based on extracts from the following urban science books:


https://www.cambridge.org/core/books/urban-planet/05E1CEDF6B9DF4E4B95AB8B4474C3C71#


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THE EMERGENCE OF A NEW URBAN SCIENCE

Lecture 1  Course Overview (10/01)

Scope of Urban Research Problems: Patterns, Processes, and Change


ebook

II. RESEARCH DESIGN AS AN EMERGENT PROCESS

Lecture 2  The Process of Scientific Research (10/06)


Seminar 1: Big data and Small Data (10/08)


Lecture 3 Research Questions (10/10)


Interactive Session 1: Urban Science: Defining Research Questions (10/15)


Examining indicators of socio-ecological wellbeing across US Metro Areas.

Lecture 4 Research Approaches (10/20)


Thomas R. Black (1999), Chp. 3: Initial Sources of Invalidity and Confounding and Chp. 4: Basic Designs.

Gary King, Robert Keohane, & Sidney Verba (1994), Designing Social Inquiry: Scientific Inference in Qualitative Research, Chp. 1: "The Science in Social Science"

The Oxford Handbook of Quantitative Methods II, Ch 2. Overview of Traditional/Classical Statistical Approaches

Interactive session 2: Team Pilot Project: Defining the research questions (10/22)
III. OBSERVATIONS AND ANALYSIS

Lecture 5  Sampling, Measurements, and Observations (10/27)


David Ford, Scientific Method for Ecological research (2000), Chp. 6 The Art of Measurement and Experiment; Chp. 7: Methods of Reasoning in Research; Chp.:8: Assessment of Postulates.


Interactive Session 3:  Reading Discussion on Social Heterogeneity (1/29)

Interactive Session 4:  Team Pilot Project: Data modeling (11/05)

V. MODELING

Lecture 6  Modeling Coupled Human-Natural Systems (11/10)


132. http://dx.doi.org/10.1017/ S1355770X12000460


Interactive Session 5:  Reading Discussion on Social Equity (11/12)

Lecture 7 Agent Based Models (11/17)

The Oxford Handbook of Quantitative Methods II, Ch. 8. Spatial Analysis.

• Badham J. 2008 A Compendium of Modeling Techniques. Integration Insight. Australian National University

Interactive Session 6: Reading Discussion on Selected PNAS paper (11/19)

VI. SCIENTIFIC INFEERENCE

Lecture 08 Internal Validity & Causality (11/24)


Interactive Session 7: Team Projects Review (12/01)

Interactive Session 8: Team Pilot Projects preparation (12/03)

VII. SYNTHESIS

Lecture 10 Synthesis (12/08)


The_oxford_handbook_of_quantitative_methods_i, Ch 22. Monte Carlo Analysis in Academic research.

How to write a first-class paper https://www.nature.com/articles/d41586-018-02404-4

Pilot Projects Team: Work on final reports and presentations (12/10)

Final Papers due: Dec. 15 @5:00 pm