



DEPARTMENT OF POLITICAL SCIENCE
UNIVERSITY OF CHICAGO

TRAINING IN RESEARCH METHODS AND FORMAL THEORY
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DEPARTMENT COMMITTEE ON RESEARCH METHODS AND FORMAL THEORY

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Formal theory and research methods in political science

Graduate education in political science trains students to become professional social scientists. An essential aspect of graduate training – indeed, what most distinguishes graduate from undergraduate education in the social sciences – is the development of the research skills that enable students to become productive, original scholars. Formal theory, and quantitative and qualitative research methods provide a curriculum that helps students to develop the needed tools.

Training in research methods includes instruction in statistical methods, but quantitative methods are not exhaustive of the field. Political science has always encompassed a variety of approaches, from formal mathematical analysis to textual language analysis, and faculty and graduate students at Chicago employ a wide range of methodologies. The department offers coursework in both qualitative, and quantitative methodologies. Thus, students who are interested in qualitative methodologies should read on, because there is something here for you.

At the moment, the most developed curriculum in the field employs mathematical methods, which divides into two broad categories: formal theory and quantitative methods. Formal theory includes decision theory, game theory, social choice theory, stochastic processes, network analysis, and other kinds of mathematical modeling. It is logical, mathematical and theoretical: formal modelers construct mathematical representations of political behavior and logically consistent frameworks for evaluating politics. Quantitative methods in political science are a distinct mode of analysis and include elements of statistics, econometrics, and psychometrics. They are inferential, mathematical and empirical: methodologists develop investigative tools to guide theoretical inquiry and test propositions.

Statistical methods are widely used in the study of American and European politics, particularly in public opinion, elections, and party systems. In international relations, there is a large quantitative literature on the causes of war, the effects of regime types on trade, and political determinants of international financial flows. And in policy analysis and evaluation research, statistical methods have found common usage in studies of education, race, poverty, crime, and housing.

Formal theory has found many of its most fruitful applications in political theory, where it is used in the study of ethics, democratic theory, and many other topics. Formal models are also of major importance in international relations, notably in the theory of deterrence and in studies of

international cooperation. American and comparative political studies employ formal theory in studies of elections, legislatures, bureaucracies, party systems, and regime transitions, just to name a few.

Students have found strong mathematical skills to be a substantial professional asset. Today, every field of political science is influenced by formal models and statistical methods, and no broad education in the discipline is complete without some understanding of their uses.

The curriculum in formal theory and research methods

The department strongly recommends that all graduate students acquire the skill set necessary for successful progress as producers of research within the first year of coursework prior to beginning research on their M.A. thesis. The notion of a skill set will vary by the specific research interests of the students. The department privileges no particular method. Students will discuss with their advisors the skill set they will need and will agree on a program of study. The DGS will confirm that these conversations have taken place. For example, among those students whose research may involve quantitative approaches, the first year should include Mathematical Foundations of Political Methodology, Linear Models, and Causal Inference.

The normal expectation for first-year quantitatively-oriented graduate students will be that they follow this quantitative track. For students whose research may involve formal theory and mathematical modeling, the first year should include courses in game theory and social choice. For students who intend to pursue political theory and qualitative research, the skill set is less established but may entail language training, ethnography training, interpretive methods, archival research, or other methodological or substantive courses.

The following listing provides an overview of the department's offerings in formal theory and research methods. Because faculty teaching schedules change, the precise offerings change from year to year, and because every student brings a unique background to the program, no document can cover all the possibilities. We urge students to consult members of the Methods Committee and other faculty advisors for personal advice.

Note: Inclusion on these lists indicates courses of interest to students who desire training in formal modeling, quantitative methods, and qualitative methods. It does not guarantee that the course will satisfy distribution requirements in these fields.

Quantitative Methods

The quantitative methods sequence prepares students to conduct empirical research in political science and provides an introduction to the skills necessary to be a political methodologist. Political Science is an increasingly empirical and quantitative discipline that relies on a wide variety of data sources and strategies for learning about the political world. To engage with the increasingly large methodological literature in political science and across the social sciences requires competency in programming, research design, statistics, and data science.

The quantitative methods training is intended to help students develop core competencies across all four critical areas of data research. It also serves as an introduction to more advanced classes in the department and across the university. Students who complete our core sequence will be well prepared to do quantitative political science research, complete the quantitative methods preliminary exam, and ready to start the more advanced coursework necessary to become political methodologists. Students interested in doing primarily qualitative work or political theory are encouraged to take courses in the quantitative methods sequence. The skills taught in the course will be useful in their own research and empower the students to read (and critique!) empirical political science.

Students interested in taking the quantitative methods exam will be required to take the entire quantitative methods sequence with exceptions made sparingly and only with a formal application to members of the quantitative methods group. That sequence is:

Quantitative Analysis introductory courses

Introductory Math Camp (Offered at End of Summer)

A brief (re)introduction to basic mathematical concepts and computing skills.

43401 Mathematical Foundations of Political Methodology

Introduction to Mathematical and Probabilistic tools for doing formal and quantitative political science. Students are introduced to the R programming language.

30700 Introduction to Linear Regression

Introduction to the linear model, the workhorse tool in quantitative political science research. Students continue development of their R programming skills.

30600 Causal Inference

Introduction to the statistics causal inference literature. Topics include: potential outcomes, experimental methods, and research design for observational data.

- 43100 Maximum Likelihood (Model Based Inference)
Analysis of choice-based models, counts, sequences, duration, proportions, and latent variables
- 43502 Machine Learning
Introduction to advanced models for prediction and data compression. Students are introduced and use the Python programming language.

Once students complete the core sequence they are encouraged to take more advanced courses offered within the department and across the university. Please consult the methods group for more information about the courses.

- 42120 Bayesian Inference in Political Science (staff, currently not offered)
- 43200 Advanced Maximum Likelihood (Brehm)
Coverage varies; topics to be drawn from truncated and censored data, hierarchical models, measurement theory, introduction to Bayesian inference (PQ: PLSC 43100).
- 43410 Introduction to Multilevel Modeling (staff, currently not offered; see SOCI 30012)
Analysis of complex interaction and classification within the clustered data.

Please also see the section below on superb offerings in advanced methods in other departments at the University of Chicago.

Note: PLSC 30500, Introduction to Research Design, is required of all students in their first year. Additionally, the department strongly encourages students to take the Social Sciences Division's math camp offered in the weeks prior to the Autumn Quarter.

Taking a comprehensive field exam in quantitative methodology

The methods faculty will offer the quantitative methods exam each spring and typically students will take the exam at the end of their second year. Students should declare their intention to take the exam at the start of the second year to the methods faculty member chairing the exam for that year. There will be a meeting in October of each year with graduate students potentially interested in taking the exam to explain the exam further and to address any questions.

Prerequisites for the Quantitative Methods Exam

Students taking the quantitative methods exam when they plan to either be practicing methodologists or advanced users of recent methodological advances. To that end, students must engage in significant coursework before taking the exam. Within the department, students are expected to complete the five course methods sequence:

1. Mathematical Foundations of Political Methodology
2. Linear Models
3. Causal Inference
4. Maximum Likelihood
5. Machine Learning

In addition, students are encouraged, but not required, to complete an advanced methodological course in the department (such as Advanced Maximum Likelihood, Bayesian Inference, Multi-level Modeling, Network Analysis) or an equivalent or higher level course offered at another department. We encourage students to consult with the methods group when choosing these additional courses.

A student may petition to waive these requirements, though these petitions will only be granted in extraordinary circumstances.

Format and timing of the quantitative methods exam

The methods exam will take place in two parts. The first part is a closed book exam that will test core concepts in statistics. The second is an open book exam that will be completed using a computer and will test data analysis skills. Both exams will take place on the same day. The closed book exam will run from 9am to 12 pm. Students will be given a one-hour break and then will take the open book portion from 1pm to 5pm.

Formal theory

The formal theory sequence prepares students to develop and analyze rigorous analytical social science theories. It provides the basic analytical skills required in formal political theory and political economy. Formal theories serve as the foundation of all empirical political science: precisely and reliably interpreting data and empirical relationships requires a coherent theoretical framework. When properly employed, formal methods ensure the logical coherence of theoretical assumptions and conclusions.

Training in the formal theory field within the department is centered on a three-course sequence composed of two quarters of game theory (30901 & 31000) and one quarter of social choice theory (40801). As a whole, these courses cover the basic tools and concepts of formal political theory and prepare students for more advanced classes in the department and across the university.

Formal theory introductory courses

- 30901 Game Theory I (Nalepa/Patty)
Introduction to static and dynamic games of complete information, including the coverage of two basic solution concepts (Nash, SPE) (PQ: PLSC 30100, when offered).
- 31000 Game Theory II (Nalepa/Patty)
Intermediate game theory focusing on games of incomplete information (PQ: PLSC 30901).
- 40801 Social Choice (Penn)
Introduction to axiomatic choice, preference aggregation, and core existence.

Formal theory optional courses

- PLSC 40200 Stochastic Models of Social Processes (Padgett)
Dynamic, probabilistic models for public opinion, learning, mobility, etc. (PQ: statistics course).
- PLSC 35801 Formal Models in Comparative Politics (Nalepa)
Newly published or still in press papers in Comparative Politics that employ formal modeling, including models of state-building, authoritarianism, regime change, corruption & clientelism (PQ: PLSC 30901 & 31000).
- PPHA 42310 The Political Economy of Development (Robinson)
Introduction for Ph.D. students to the research literature in the political economy of development.
- ECON 36101 Economic Models of Politics (Myerson & van Weelden)
Introduction to current research in political economics.
- PLSC 40815 New Directions in Formal Theory (Penn)
Survey of recent research in formal political theory. Topics include models of institutions, groups, and behavior, spanning American politics, comparative politics, and international relations. Tools include game theory, network analysis, simulation, axiomatic choice theory, and optimization theory.

Taking a comprehensive exam in Formal Theory

Students wishing to take the formal theory exam must complete the three-course sequence composed of 30901, 31000, and 40801 and one additional course in formal political theory or political economy. Any student who has satisfied this requirement can take the field exam in Formal Theory.

The classes listed in this document automatically count for the fourth course requirement. Other courses may count as well. Offerings change annually, so students are advised to ask the formal theory faculty (Nalepa, Patty, and Penn) regarding whether an unlisted course satisfies the requirement and/or suggestions about other courses.

Format and timing of the formal theory exam

The formal theory exam will consist of a closed book, closed notes exam running from 9am to 5pm on a single day. A typical exam will consist of one question corresponding to each of the three required courses. Passing the exam will require mastery of the material in all three of the required introductory courses.

Qualitative methodology

Qualitative approaches seek to describe, interpret, and/or explain political action and institutions through direct and systematic analysis of specific empirical contexts. The department frequently offers courses that encourage richer study of these areas. There is no comprehensive exam in qualitative methods.

Qualitative methods introductory courses

- 33300 Interpretive Methods in the Social Sciences (Wedeen)
Broad introduction to a wide variety of approaches to comparative research.
- 43700 Comparative Historical Analysis (Slater)
A survey of best practices in the development of historically grounded causal explanations in comparative politics and sociology.
- 50900 Seminar on the Comparative Case Study Method (Mearsheimer, Pape)

Additional resources

The appropriate curriculum in formal theory and research methods clearly depends upon each student's particular background, and we urge students to consult faculty advisors individually. For students who have prior experience or who wish to be first-rate producers of formal models or quantitative research, the best advice is to consult an advisor from the Committee on research methods and formal theory. Training in calculus and linear algebra is essential for advanced work in mathematical methods, and students who lack such training should plan to study these topics. The Mathematics Department offers calculus and linear algebra regularly. Students and faculty have occasionally organized study groups on their own to learn new material. The systematic nature of the curriculum, however, makes it possible to pursue training in these topics at several different levels.

Suggested sequences for beginners looking for a brief introduction

Formal theory: 30901 (Game Theory I); 40801 (Social Choice).

Qualitative methods: 33300 (Interpretive Methods); 50900 (Comparative Case Study Method).

Quantitative methods: 43401 (Mathematical Foundations of Political Methodology); 30700 (Linear Models); 30600 (Causal Inference).

Courses outside the department for more advanced students

Students with a strong interest in formal models or research methods are encouraged to take courses outside the department, including courses on stochastic models, advanced probability, Bayesian inference, log-linear models, models for events data, network analysis, sociological inference, microeconomics, econometrics, international economics, the philosophy of science, and the logic of inquiry.