Course Description: In this course we cover research methods for political science in seven distinct modules: 1) Prerequisites (two sessions), including calculus, probability theory, linear algebra, and basics of working with a statistical software 2) Fundamentals of regression analysis (six sessions, two modules): including regression analysis, diagnostics of inference, regessions with time series data, nonlinear regression methods and finally causal inference using regression 3) Fundamentals of game theory and rational choice (six sessions, two modules): including pure and mixed equilibria in games of simultaneous and sequential moves, games of imperfect information, repeated games and bargaining models 4) Data collection and qualitative methods (three sessions) under two main rubrics of survey and archival methods, including structured and unstructured surveys, sampling issues and archival methods and case studies 5) Panel and Bayesian data analysis (four sessions) including hierarchical and multilevel models, fixed and random effects, survival analysis and Bayesian statistical modeling 6) Policy evaluation methods in political science (three sessions) including causal analysis methods, controlled experiments, field experiments, and natural and quasi-experiments of history covering differences-in-differences, matching, regression discontinuity, and instrumental variable methods 7) Big Data in political science (four sessions) including four modules, social network analysis, text analysis, GIS, and machine learning & prediction.

Each of the modules of the course is followed by an assignment and a seminar dedicated to the discussion of the techniques utilized in the assignment, as well as review of practical matters, such as software usage and data processing and analysis.

Weekly lectures outline the core theory and methodology of political science, and demonstrate the usage of these methods in the political science literature. There are required readings assigned for each lecture.

Seminars are scheduled to help students to develop their practical skills via working with theoretical examples, data processing exercises, and in-class discussions with the instructor.
**Evaluation:** The grade for this course is based on nine assignments (total of 45%), attendance in lectures and seminars (10%), midterm (20%) and a final exam (25%). Both midterm and final exams are in-class and closed-notes.

**Readings:** Selected chapters from textbooks, and relevant papers are assigned each week. Students are expected to have read the material before attending the lecture. In case required readings are not available online or are not in the required texts, a scanned version will be provided on the course’s website.

**Office Hours:** Instructor OH: TBD, Teaching Assistant OH: TBD

**Prerequisites:** Prior exposure to linear algebra, probability and statistics, social theory, and statistical software is recommended, but not required. The basics will be covered in the first module of the course.

**Course Type:** Compulsory

**Learning Objectives:** The analytical knowledge and empirical toolbox necessary for designing and implementing a multi-method political science inquiry

**Learning Outcomes:** Design and execution of the main modules of a political science inquiry: 1) data collection and basic processing 2) modeling strategic decision making 3) quantitative analysis of panel-structured data 4) policy evaluation and casual inference 5) Big Data techniques in political science

**Course Plan:** Instruction in 7 components (9 modules) covering quantitative and qualitative methods of research in political science: prerequisites, fundamentals of research methodology (regression analysis and game theory, each two modules), research design and data collection methods—both qualitative and quantitative—methods of panel data, and policy impact evaluation, and finally Big Data methods. The goal is to encourage students to combine all the five aforementioned components in their future work.

There will be presentation slides for each session. After each assignment, there will be a seminar for practicing the skills necessary – including those for working on the assignment objectives.

**Required Textbooks:** The following textbooks can be consulted for further learning. Additional readings are assigned per week.
• Prerequisites: (JG) Jeff Gill (2006) *Essential Mathematics for Political and Social Research* Cambridge University Press


• Game Theory: (MO) Martin Osborne (2004) *An Introduction to Game Theory* Oxford University Press


• Big Data in Political Science: Lecture notes provided by the instructor

Recommended Textbooks:


• Game Theory: (DSR) Avinash Dixit, Susan Skeath and David H. Reiley Jr. (2014) *Games of Strategy* W. W. Norton & Company


Outline and Schedule

Part 1: PREREQUISITES, Calculus, Probability, Linear Algebra
• **Lecture 1: Overview of the Course—Basic mathematics of social science** First a full overview of the course, outlining the elements of a political scientific inquiry—then we start with the fundamentals of linear algebra, vector operations and probability theory, as well as some essential calculus refreshers. A good understanding of vector operations and probability theory is key to research design and data management in political science.

  - Required Reading
    * *Research Design*: KKV, Ch. 1
    * *Linear Algebra: Vector operations*: JG, Ch.s 3 and 4
    * *Fundamentals of Probability*: JG, Ch.s 7 and 8
    * *Calculus*: JG, Ch. 5
  
  - Recommended Reading

• **Lecture 2: Social Science Data** Introduction to Data Processing

  - Required Reading
    * *Research Design*: KKV, Ch. 2 and Ch. 3
    * *Data as vectors & fits and prediction (Matrix and vector algebra + Probability theory)*: JW1, Ch. 1
    * *R Introduction*: Two intros to R, available at
      [https://cran.r-project.org/doc/manuals/R-intro.pdf](https://cran.r-project.org/doc/manuals/R-intro.pdf), and
  
  - Recommended Reading
    * *Coding Data*: Michael Alvarez, Jose Antonio Cheibub, Fernando Limongi, and Adam Przeworski (1996), Classifying Political Regimes, *Studies in Comparative International Development* 31(2), 3–36

  – ASSIGNMENT 1, Due TBD
• Seminar 1: Introduction to Statistical Analysis in R with Sample Data
  – in class workshop with sample data, action plan and link to data TBD

Part 2: FUNDAMENTALS, Regression Analysis

• Lecture 3: Fundamentals of regression analysis, simple Ordinary Least Squares (OLS)
  – Required Reading
    * OLS, fundamentals and goodness of fit: JW1, Ch. 2
    * Maximum Likelihood (ML) estimation and hypothesis testing: JW1, Appendix C
  – Recommended Reading
    *

• Lecture 4: Multiple Regressions–Definition and Diagnostics of Inference
  – Required Reading
    * Fundamentals & Inference tests: JW1, Ch.s 3, 4
    * Multiple Regression Issues: JW1, Ch.s 5,6
  – Recommended Reading
    *

• Lecture 5: Multiple Regression-II
  – Required Reading
    * Discrete Variables: JW1, Ch. 7
    * Heteroskedacity: JW1, Ch. 8
    * Regression Issues: JW1, Ch. 9
  – Recommended Reading
    *
– ASSIGNMENT 2, Due TBD

• Seminar 2: Linear Regression in R with Sample Data
  – in class workshop with sample data, action plan and link to data TBD

• Lecture 6: Regression with Time Series Data
  – Required Reading
    * Fundamentals: JW1, Ch. 10
    * Issues, Serial Correlation and Heteroskedacity: JW1, Ch.s 11, 12
  – Recommended Reading
    *

• Lecture 7: Nonlinear Regression: Logit and Probit, GLM, Poisson, Negative Binomial
  – Required Reading
    * Logit and Probit: JW1, Ch. 17
    * GLM: JW2, Ch. 13
    * Probit, Logit, Poisson & Negative Binomial: JW2, Ch. 15, 18
  – Recommended Reading
    *

• Lecture 8: Regression & Causal Inference, Instrumental Variable Analysis (IV) & Two Stage Least Squares (2SLS)
  – Required Reading
    * IV and 2SLS: JW1, Ch. 15
    * Causal Inference: GH, Ch. 9, 10
  – Recommended Reading
• Seminar 3: Time Series, Nonlinear and 2SLS Regressions in R with Sample Data
  – in class workshop with sample data, action plan and link to data TBD

Part 3: FUNDAMENTALS, Game Theory & Rational Choice

• Lecture 9: Fundamentals–Nash Equilibrium in Simultaneous-Move games
  – Required Reading
    * Fundamentals, Discrete Strategy Nash Equilibrium: MO, Ch.s 1, 2, and 3
  – Recommended Reading
    * DSR, Ch.s 1, 2, and 4

• Lecture 10: Equilibria in Sequential Games
  – Required Reading
    * Backward Induction and Subgame Perfect Equilibria: MO, Ch.s 5, 6, and 7
  – Recommended Reading
    * DSR Ch. 3

• Lecture 11: Mixed Strategy Equilibria
  – Required Reading
    * Mixed Strategy Equilibria: MO, Ch. 4

ASSIGNMENT 3, Due TBD
– Recommended Reading
  * DSR, Ch.s 5, 6, and 7

– ASSIGNMENT 4, Due TBD

• Seminar 4:
  – *In class workshop, applications and further mathematical illustrations*

• Lecture 12: Games of Imperfect Information
  – Required Reading
    * *Bayesian Games, Bayesian Subgame Perfect Equilibria (SPE), Signaling Games*: MO, Ch.s 9 and 10
  – Recommended Reading
    * DSR, Ch. 8

• Lecture 13: Repeated Games
  – Required Reading
    * *Repeated Games (PD)*: MO, Ch.s 14 and 15
  – Recommended Reading
    * DSR, Ch. 10

• Lecture 14: Strategic Decision Making in Politics, Examples
  – Required Reading
    * *Example 1, Collective Action Games*: DSR, Ch. 11
    * *Example 1, Mutually Assured Destruction (MAD) and Nuclear Deterrence*: DSR, Ch. 14
- *Example 1, Strategic Voting: DSR, Ch. 15

  – Recommended Reading

  * DSR, Ch.

  * *Bargaining: MO, Ch. 16*


- ASSIGNMENT 5, Due TBD

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- **Seminar 5:** Game theory examples and mathematical illustrations

  – *In class workshop with illustrative examples*

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**Part 4: INTERLUDE: QUALITATIVE RESEARCH DESIGN, DATA METHODS & VARIABLE PRODUCTION**

- **Lecture 15: Survey Methods I-Principles, Sampling Issues** The following three lectures consider the elements of the “quantitative/qualitative” debate, while providing pragmatic instructions on landing a survey and conducting archival research, both for a data-oriented project.

  – Required Reading

    * An econometric project plan: JW1, Ch. 19

    * Principles of Survey Design: SM, Ch.s 1, 2

    * Survey Sampling Issues: SM, Ch.s 3, 4

  – Recommended Reading


**Lecture 16: Survey Methods II, Structured & Unstructured Surveys, Interviews**

- Required Reading
  * **Interview:** SM, Ch.s 5, 9
  * **Nonresponse:** SM, Ch. 6
  * **Coding and Evaluating Survey Results:** SM, Ch. 7,8,10

- Recommended Reading
  * James Mahoney and Gary Goertz (2006) A Tale of Two Cultures: Contrasting Quantitative and Qualitative Research, Political Analysis, 14(3): 227–249

**Lecture 17: Archival and Observational Methods, Case Studies**

- Required Reading
  * **Comparative Historical Research:** James Mahoney and Dietrich Rueschemeyer, eds. (2003) Comparative Historical Analysis in the Social Sciences Cambridge University Press, Selections
  * **Counterfactuals:** ed.s Philip Tetlock and Aaron Belkin (1996) Counterfactual Thought Experiments in World Politics Ch.s 1 and 8
  * **An Example:** Daron Acemoglu, Simon Johnson, James Robinson (2005) Institutions as the Fundamental Cause of Long-Run Growth, in Handbook of Economic Growth, Volume 1A. Edited by Philippe Aghion and Steven N. Durlauf, Elsevier B.V

- Recommended Reading


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ASSIGNMENT 6, Due TBD

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• Seminar 6: data processing
  
  in class workshop on survey and archival methods, offline and online knowhow

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Part 5: QUANTITATIVE METHODS, PANEL DATA, BAYESIAN INFERENCE

• Lecture 18: Econometrics of Panel Data Analysis- FE, RE
  
  Required Reading
  
  * Policy Analysis with Panel Data: JW1, Ch. 13
  * Fixed Effects, Random Effects: JW1, Ch. 14
  
  Recommended Reading
  
  *

• Lecture 19: Temporal and Cross Sectional Dependency-Hierarchical Models
  
  Required Reading
  
  * Dependency in Time, Forecast: JW1, Ch. 18
  * Hierarchical Linear Models, Clustering: JW2, Ch. 20
– Recommended Reading

* Multilevel Models: GH, Ch.s 11, 12, 13
* Ordered Response Models: JW2, Ch. 16

• Lecture 20: Survival Analysis, Treatment Effect in Panel Data

– Required Reading

* Duration Models: JW2, Ch. 22
* (Preparation for the next module) Average Treatment Effects: JW2, Ch. 21

– Recommended Reading

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• Lecture 21: Bayesian Statistical Modeling

– Required Reading

* Bayesian Analysis, Estimation Models: Andrew Gelman et al (2013) (AG) Bayesian Data Analysis, Chapman and Hall/CRC, Ch.s 1, 2, 3
* Bayesian Hierarchical Models: AG Ch. 5

– Recommended Reading


– ASSIGNMENT 7, Due TBD

• Seminar 7: Statistical software lab with panel data

– in class workshop with sample data, action plan and link to data TBD

Part 6: POLICY EVALUATION METHODS
• Lecture 22: Policy Evaluation and Causal Analysis

- Required Reading
  * Matching: AP1, Ch. 2
  * Regression Discontinuity: AP1, Ch. 4
  * Differences-in-Differences: AP1, Ch. 5

- Recommended Reading
  * Instrumental Variable Methods: AP1, Ch. 3

• Lecture 23: Controlled Experiments (Mathematics and Methods), Field Experiments

- Required Reading
  * Randomization: AP1. Ch. 1, AP2. Ch. 2

- Recommended Reading

• Lecture 24: Policy Evaluation & Natural and Quasi Experiments of History

- Required Reading
  * Principles: MW Ch. 1
  * Sample Cases: Jared Diamond and James Robinson ed.s (2011) *Natural Experiments of History*, Belknap Press, Selections
• Seminar 8: Experiments Workshop–Mathematics of Causality
  – *in class workshop with sample data, action plan and link to data TBD*

Part 7: BIG DATA METHODS IN POLITICAL SCIENCE

• Lecture 25: Big Data Module One: Social Network Analysis
  – Required Reading
    * Instructor’s Lecture Notes (Link TBD)
    *
  – Recommended Reading
    *

• Lecture 26: Big Data Module Two: Text Analysis
  – Required Reading
    * Instructor’s Lecture Notes (Link TBD)
    *
  – Recommended Reading
    *

• Lecture 27: Big Data Module Three: GIS
- Required Reading
  * Instructor’s Lecture Notes (Link TBD)
  *
- Recommended Reading
  *

- **Lecture 28: Big Data Module Four: Machine Learning & Prediction**

  - Required Reading
    * Instructor’s Lecture Notes (Link TBD)
    *
  - Recommended Reading
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- **ASSIGNMENT 9, Due TBD**

- **Seminar 9: Big Data in political science, methods workshop**

  - *in class workshop with sample data, action plan and link to data TBD*