POLS 8810: Uses of Intermediate Statistical Methods

Spring 2024

Georgia State University
Department of Political Science

Instructor:	Dr. Michael P. Fix	Meeting Time:	R 12:45 pm–03:15 pm
My Office:	Langdale 1007	Class Location:	Langdale 1076
Office Hours:	TR 9:30–10:30a.m.	Methods TA:	Ozlem Tuncel
or by appt. at	https://calendly.com/mpfix1	TA Office Hours:	T 2:00–4:00 pm R 10:00 am–12:00 pm
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Course Objectives

This is the second course in the quantitative methods sequence in this department. It is designed to further develop students' understanding of, and ability to use, applied quantitative data analysis techniques. This course assumes a basic understand of core principles of statistics and probability, a basic mathematical knowledge (including linear algebra and calculus), and familiarity with at least one statistical software program including basic programming. The primary topical focus of this course will be on linear regression. The main goal of the course will be to give students the tools to critically evaluate regression results in published work and to correctly use regression analysis in their own research. To that end, we will cover essential practical topics such as model specification and presentation of results.

Required Texts

- Gill, Jeff. 2006. *Essential Mathematics for Political and Social Research.* New York: Cambridge University Press. [**Full Text available online through GSU Libraries, no need to purchase.** However, I did see a used copy on Amazon for about $5. If you are going to do a lot of quant work in your career, this is a useful text to have a permanent copy of—especially for that price—as you will find yourself occasionally needed to remember some mathematical rule that you have since forgotten (or at least I do).]
- Fox, John. 2015. *Applied Regression Analysis and Generalized Linear Models.* 3rd Edition. Thousand Oaks, CA: Sage. (You should be able to find a used version of the 2nd edition for significantly cheaper. You should do so.)
- There are several articles assigned throughout the semester. You can find a pdf copy of each of these in this Dropbox folder.

Recommended Texts

- Fox, John, and Sanford Weisberg. 2011. *An R and S-Plus Companion to Applied Regression.* 2nd Edition. Thousand Oaks, CA: Sage. [A companion to the Fox text. Contains R code and examples for topics in the main text.]
- Weisberg, Sanford. 2013. *Applied Linear Regression*, 4th Ed. New York: Wiley. [A good text covering the same material as Fox. I considered this for the main course text.]
- Kennedy, Peter. 2008. *A Guide to Econometrics*, 6th Ed. Cambridge: MIT Press. [One of the few texts with "econometrics" in the title that I really like. Provides a very easy to understand overview of the topics covered in this class. Especially useful for those taking a qualifying exam in methods who need a good review of Gauss-Markov assumptions.]

- Gelman, Andrew, and Jennifer Hill. 2006. *Data Analysis Using Regression and Multilevel/Hierarchical Models.* New York: Cambridge University Press. [Must have text if doing anything with multilevel models.]
- Gelman, Andrew, Jennifer Hill, and Aki Vehtari. 2020. *Regression and Other Stories.* New York: Cambridge University Press. [I've heard good things about this text. I have not acquired a copy yet.]

Course Requirements

Final grades for this course will be comprised of four (4) components:

Participation	5%
Problem Sets	20%
Research Project	50%
Final Exam	25%

Final grades will be calculated using the following scale:

A	89.5-100%
B	79.5-89.49%
C	69.5-79.49%
D	59.5-69.49%
F	0-59.49%

1. **Participation** → As this is a graduate level course, participation in discussion is an essential component of the learning process. While the nature of a methods class requires that there will be a good deal of lecture, there will be ample opportunity for students to offer their thoughts. It is my expectation that all students will avail themselves of these opportunities. Also, I will assign supplementary readings some weeks that provide an application of a technique that we covered, and about which we can begin the following class with a brief discussion.
2. **Problem Sets** → Problem sets will be distributed periodically throughout the semester. Most will focus on the application of the specific statistical techniques to actual or simulated datasets I will provide. As noted above, I require that you save a batch or log file for all analyses that you can present to me upon request should I need to replicate your results. For the copy you submit, all results presented must be formatted into professional looking tables (i.e. do not simply cut and paste the raw output from your software package) and must follow all of the "guideline for written assignments" outlined below. Collaboration on problem sets is not only allowed, but it is encouraged. However, each student must complete a final write-up on their own to submit.
3. **Research Project** → Each student will be responsible for completing a research paper of the quality one would expect to submit for a professional conference. The paper must either 1) apply one of the techniques covered in the course to address a substantive question in political science scholarship, 2.) introduce a new or innovative measurement or methodological approach that builds from one of the techniques covered in this course, or 3.) discuss some technical problem common to applied research, while offering a solution and set of recommendations for dealing with the issue. The research project will be due in stages as outlined below:
    - **Proposal**: On Jan. 25, each student must submit a short research proposal outlining their project idea (one paragraph is all you need here). This should mirror a conference abstract. This is worth 5% of the final project grade.
    - **Draft 1**: A complete and relatively polished draft of you paper will be due on March 28. This will need to be submitted electronically as email attachment. This draft should be blinded (i.e. you name and other identifying information should be removed). This is worth 5% of the project grade.

- **Reviews**: Each student will be assigned one paper to review. The reviews will be due on April 4. These will need to mirror the reviews one would write as a referee for a journal manuscript in substance and style. Reviews should be blinded (i.e. you name and other identifying information should be removed). This is worth 5% of the project grade.
- **Presentation**: The final class session (April 18) will be reserved for student presentations. An independent assessment of the presentation focused on stylistic, aesthetic, and other criteria related to the substance will be evaluated in addition to the substance. This is worth 20% of the project grade.
- **Final Paper**: Your final paper should be of the quality you would submit for an academic conference. It should be polished and complete. It should also take into account comments and suggestion made by the anonymous reviewer. It should be submitted as a physical, hard copy (for grading) and via iCollege (for plagerism detection). This is due on April 18. This is worth 60% of the project grade.
- **Memo**: Along with your paper, you will also submit a memo discussing the edits you made in light of the reviews. This should mirror the memo one would submit along with their revised manuscript after an R&R. This is worth 5% of the project grade.

4. **Final Exam** A take-home final exam will be distributed at the final class meeting (April 18), and students will have 48 hours to complete and submit a typed response. (Note: if several students in this course have another seminar with a take-home final at the same time as this one, please let me know early in the semester and I will alter the distribution date of this exam if possible.) Students may use any necessary resource in completing their exam such as textbooks, articles, and class notes. However, unlike the problem sets, collaboration with other students is strictly prohibited on the exam. Details on the format will be provided closer to the end of the semester.

Grading Policies

1. **Late Work**: As this is a graduate level course, attendance for every class is an expectation. However, I understand that emergencies do occur. If you are not going to be able to make class due to some type of emergency situation, you need to contact me in advance and make arrangements to get any assignments to me. You are also responsible for getting notes for any material covered in your absence from one of your fellow students.

2. **Written Assignments**: All written assignments are due at the beginning of the class period on the assigned due date. All assignments must be prepared according to the following guidelines. If these are not followed, points will be deducted:

   (a) Type your name and the title of your paper on the top of the first sheet of paper.
   (b) Use standard letter ($8\frac{1}{2}$ x 11") paper.
   (c) Use with 1" margins.
   (d) Use size 11 or 12-point font.
   (e) Use only Times New Roman or Cambria fonts (if using MS Word).
   (f) Type your name and the title of your paper on the top of the first sheet of paper.
   (g) Print on unlined white paper which does not have hole punches or tears.
   (h) The paper you use must not have any material on the reverse side.
   (i) Print only on one side of the paper.
   (j) Print in black ink.
   (k) Double space.

(l) Fasten your work with a single staple placed in the upper-left corner of the page. (Note: No points will be deducted for this item, but your assignment will not be accepted until you correct the problem.)

(m) Fasten the pages in their proper order.

(n) Do not, for any reason, write on your typed work with a pen or pencil or any other writing instrument.

(o) All assignments should be submitted in hard copy unless otherwise specified. Those assignments that are to be submitted electronically, should be emailed directly to me in pdf format. No assignments will be accepted as Word documents.

(p) (Note: If using LaTeX, I will be happy to provide a template that conforms to all these requirements upon request.)

Methods TA

Ozlem Tuncel (e-mail: otuncelgurlek1@student.gsu.edu), is the methods TA for this course. [Insert information about availability] Lab hours will be dedicated to working on a variety of topics including software issues, supplementing class material, questions about problem sets, and help with general methodology matters.

Software Note

It will be essential for this course that you have a solid understanding of at least one statistical software package in order to complete all of the problem sets and your research project. While I will provide some examples in class in R to help you understand the basics, **it is expected that you will primarily learn the necessary software outside of class. The purpose of this course is NOT to teach you how to use statistical software.**

While there are a variety of software packages available (both commercial and open-source) that are sufficient for the techniques we will cover in this course, I will primarily use R when I provide examples in class. The recommended companion to the primary course text provides additional syntax for estimating most of the models we will cover in R. Additionally, you will need to keep copies of all code files for homeworks and your final paper. If it becomes necessary for me to replicate any of your analyses, you will need to supply these files upon request. If you have a strong desire to use an alternative software package for your analyses, this is your choice but I recommend that you discuss it with me in advance. However, I am unfamiliar with any packages other than R and Stata™and will not be able to provide assistance should you have problems. Use of Excel or SPSS is **NEVER** acceptable.

In addition to statistical software, you will also need a way to typeset mathematical equations. As you will note below, I require all assignments to be typeset. While MS Word has the ability to do this, it is cumbersome and visually unappealing. Additionally, I do not use MS Word, so I will be of no use whatsoever should you encounter a problem with its mathematical typesetting functions. As such, I recommend that you take the opportunity to learn LaTeXwhile in this class. Not only will it allow you to produce documents that look professionally typeset, but it will save you time down the road when you begin to put together your thesis and/or dissertation. Any student interested in learning more about LaTeXcan find lots of information to get started on the Computing page I have set up on my website.

Communication Policy

E-mail is the preferable method for contacting the instructor for any reason, and the only way to guarantee that I have received a message. You should not assume that I have received an e-mail unless, and until, you get a reply from me. If you do not receive a reply to an e-mail within 24 hours (weekends excluded), you

should resend the e-mail. **If I do not receive an e-mail from you, it is equivalent to you having never sent one.**

Expectations for Classroom Behavior

It is the expectation of the instructor that students will behave in a professional manner in this class. Many of the issues discussed are ones that many of us have strong personal and emotional feelings about. However, we must understand that the purpose of this class is to discuss the foundations of legal doctrine on these issues not our own personal views or biases. Moreover, when contoversal topics are discussed, we must remember than intellectual pluralism and academic freedom are core to the mission of higher education. Remembering this allows for respectful discussions that is inclusive of a diversity of views.

Diversity, Inclusivity, and Respect Statement

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of all diversity including gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your comments (in the discussion posts and in person) related to the class and content will be encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups.

FERPA Statement

In keeping with USG and university policy, this course website will make every effort to maintain the privacy and accuracy of your personal information. Specifically, unless otherwise noted, it will not actively share personal information gathered from the site with anyone except university employees whose responsibilities require access to said records. However, some information collected from the site may be subject to the Georgia Open Records Act. This means that while we do not actively share information, in some cases we may be compelled by law to release information gathered from the site. Also, the site will be managed in compliance with the Family Educational Rights and Privacy Act (FERPA), which prohibits the release of education records without student permission. For more details on FERPA, click here.

Academic Honesty

Georgia State University has clearly articulated its policies governing academic integrity and students are encouraged to carefully review the Policy on Academic Honesty available through the Dean of Students Office. Any deviation from these expectations will result in academic penalties, and the potential for disciplinary action. At a minimum, any violation will result in a grade of zero (0) on the specific assignment involved. The area of greatest potential risk for intentional and inadvertent academic dishonesty is plagiarism. Plagiarism includes, but is not limited to, paraphrasing or directly quoting the published or unpublished work of another individual without full and clear acknowledgment in the form of a citation. The University's Policy on Academic Honesty is available here.

Prohibition on Posting Instructor-Generated Materials

The selling, sharing, publishing, presenting, or distributing of instructor-prepared course lecture notes, videos, audio recordings, or any other instructor-produced materials from any course for any commercial purpose is strictly prohibited unless explicit written permission is granted in advance by the course instructor. This includes posting any materials on websites such as Chegg, Course Hero, OneClass, Stuvia, StuDocu and other similar sites. Unauthorized sale or commercial distribution of such material is a violation of the instructor's intellectual property and the privacy rights of students attending the class, and is prohibited.

Special Needs

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. Students who wish to request accommodation for a disability may do so via the Access and Accommodations Center (AACE) at `https://access.gsu.edu/`. Students may only be accommodated upon issuance of a signed Accommodation Plan by the AACE Center (see here for more information) and are responsible for providing a copy of that plan to instructors of all classes in which accommodations are sought.

Basic Needs Statement

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. Furthermore, please notify the professor if you are comfortable in doing so. This will enable us to provide resources that we may possess. The Embark program at GSU provides resources for students facing homelessness and Panther's Pantry provides resources for students facing food insecurity.

Sexual Harassment

In instances of sexual misconduct, the present instructor(s) and teaching assistants, are designated as Responsible Employees who are required to share with administrative officials all reports of sexual misconduct for university review. If you wish to disclose an incident of sexual misconduct confidentially, there are options on campus for you do so. For more information on this policy, please refer to the Sexual Misconduct Policy which is included in the Georgia State University Student Code of Conduct.

End of Course Evaluations

Your constructive assessment of this course plays an indispensable role in shaping education at Georgia State. Upon completing the course, please take time to fill out the online course evaluation.

Disclaimer

The course syllabus provides a general plan for the course; deviations may be necessary.

Course Outline

(Note: all page numbers for Fox are for the 3rd Edition. Page numbers in the 2nd Edition will be different.)

- **Week 1 (Jan. 11): Linear Algebra Review**
  - Required Readings:
    - Gill, Chapters 3 & 4 (sections 4.1–4.6 only).
  - Recommended Readings:
    - (Note: Each of these three "Little Green Books" provides a sufficient overview of linear algebra. In my view, Gill does a better kob in a more accessable way. However, if you struggle with Gill's treatment, try one of these instead. All are available for free through the GSU Library's subscription to Sage Research Methods.)
    - Namboodiri, Krishnan. 1984. *Matrix Algebra.* Thousand Oaks, CA: SAGE.
    - Hagel, Timothy M. 1995. *Basic Math for Social Scientists: Concepts.* Thousand Oaks, CA: Sage.

    * Fox, John. 2008. *A Mathematical Primer for Social Statistics.* Thousand Oaks, CA: Sage.
  - Assignments:
    * None

- **Week 2 (Jan. 18): Probability Review**
  - Required Readings:
    * Gill, Chapters 7 & 8
  - Recommended Readings:
    * Wannacott, Thomas H. and Ronald J. Wonnacott. *Introductory Statistics.* 5th Edition. New York: John Wiley & Sons. [Chapters 3 & 4. Note: this is the text I use for POLS 8805. It is a very good undergrad style text for intro statistics and probability.]
    * Rudas, Tamás. 2004. *Probability Theory.* Thousand Oaks, CA: SAGE. (This is another of the "Little Green Books" available for free through the GSU Library's subscription to Sage Research Methods. Again, I think that Gill does a better job in a more accessable way. However, if you struggle with Gill's treatment, try this instead.)
  - Assignments:
    * None

- **Week 3 (Jan. 25): First Things First: Taking a Look at Your Data**
  - Required Readings:
    * Fox, Chapter 3
    * Nagler, Jonathan. 1995. "Coding Style and Good Computing Practices." *PS: Political Science and Politics* 28(3): 488–492.
    * Gelman, Andrew, Cristian Pasarica, and Rahul Dodhia. 2002. "Let's Practice What We Preach: Turning Tables into Graphs." *American Statistician* 56 (2): 121-30.
  - Recommended Readings:
    * Gelman, Andrew. 2011. "Why Tables are Really Much Better Than Graphs." *Journal of Computational and Graphical Statistics* 20(1): 3-7.
  - Assignments:
    * Research Proposal Due
    * Problem Set 1 Assigned

- **Week 4 (Feb. 1): Bivariate Regression I: Conceptual Overview and Estimation**
  - Required Readings:
    * Fox, Section 5.1
  - Recommended Readings:
    * Berry, William D. 1993. *Understanding Regression Assumptions.* Thousand Oaks, CA: Sage. (This is another of the "Little Green Books" available for free through the GSU Library's subscription to Sage Research Methods. It is an older, but very accessable, overview of the Gauss-Markov assumptions that will be introduced this week but are of paramount importance throughout the course.)
    * Lewis-Beck, Colin, and Michael Lewis-Beck. "Applied Regression: An Introduction." (Yet another of the "Little Green Books" available for free through the GSU Library's subscription to Sage Research Methods.
  - Assignments:

    - Problem Set 1 Due

- **Week 5 (Feb. 8): Bivariate Regression II: Inference, Hypothesis Testing, & Model Fit**
  - Required Readings:
    - Fox, Section 6.1
    - Gill, Jeff. 1999. "The insignificance of null hypothesis significance testing." *Political Research Quarterly* 52(3): 647-674. (Answers the question: Is everything we're doing here wrong?)
    - Nuzzo, Regina. 2014. "Scientific Method, Statistical Errors." *Nature* 506(7487): 150–152.
    - Yaddanapudi, Lakshmi Narayana. 2016. "The American Statistical Association statement on P-values explained." *Journal of Anaesthesiology Clinical Pharmacology.* 32(4):421-423.
    - Lewis-Beck, Michael S. and Andrew Skalaban. 1990. "When to Use R-Squared." *The Political Methodologist* 3(2):11-12. (Note: this hyperlink will access the full issue, you only need to read this short piece and the next one.)
    - King, Gary. 1990. "When Not to Use R-Squared. " *The Political Methodologist* 3(2):9-11.
    - Luskin, Robert C. 1991. "R-Squared Encore." *The Political Methodologist* 4(1):21-23. (Note: this hyperlink will access the full issue, you only need to read this short piece.)
  - Recommended Readings:
    - King, Gary. 1986. "How not to lie with statistics: Avoiding common mistakes in quantitative political science." *American Journal of Political Science* 666-687. (I know that 1986 was before many of you were born. However, many applied researchers still make the mistakes that King warned against here.)
  - Assignments:
    - Problem Set 2 Assigned

- **Week 6 (Feb. 15): Multiple Regression: Estimation and Inference**
  - Required Readings:
    - Fox, Sections 5.2, 6.2, 6.3, and 6.4
    - Berk, Richard, Lawrence Brown, Andreas Buja, Edward George, Emil Pitkin, Kai Zhang, and Linda Zhao. 2014. "Misspecified Mean Function Regression: Making Good Use of Regression Models That Are Wrong." *Sociological Methods & Research* 43(3):422–451.
    - Kastellec, Jonathan P., and Eduardo L Leoni. 2007. "Using Graphs Instead of Tables in Political Science." *Perspectives on Politics* 5:755-771.
  - Recommended Readings:
    -
  - Assignments:
    - Problem Set 2 Due

- **Week 7 (Feb. 22): Dichotomous Predictors, Non-Linearity and Data Transformations**
  - Required Readings:
    - Fox Chapter 4
    - Gelman, Andrew. 2008. "Scaling Regression Inputs by Dividing by Two Standard Deviations." *Statistics in Medicine* 27:2865-2873.
  - Recommended Readings:
    -
  - Assignments:

    - None

- **Week 8 (Feb. 29): Interaction Terms**
  - Required Readings:
    - Fox Section 7.3
    - Brambor, Thomas, William R. Clark, and Matt Golder. 2006. "Understanding Interaction Models: Improving Empirical Analyses." *Political Analysis* 14:63-82.
    - Esarey, Justin, and Jane Lawrence Sumner. 2018. "Marginal Effects in Interaction Models: Determining and Controlling the False Positive Rate." *Comparative Political Studies* 51:1144-1176.
    - Hainmueller, Jens, Jonathan Mummolo, and Xiqing Xu. 2019. "How Much Should We Trust Estimates from Multiplicative Interaction Models? Simple Tools to Improve Empirical Practice." *Political Analysis* 27:163-192.
  - Recommended Readings:
    - Friedrich, Robert J. 1982."In Defense of Multiplicative Terms in Multiple Regression Equations." *American Journal of Political Science*. 26(November):797-833.
    - Braumoeller, Bear F. 2004. "Hypothesis Testing and Multiplicative Interaction Terms." *International Organization* 58(4): 807-820.
  - Assignments:
    - Problem Set 3 Assigned

- **Week 9 (Mar. 7): Variance Issues**
  - Required Readings:
    - Fox, Sections 12.1 and 12.2
    - Long, J. Scott,and Laurie H. Ervin. 2000. "Using Heteroscedasity-Consistent Standard Errors in the Linear Regression Model." *The American Statistician* 54:217-224.
    - Primo, David M., Matthew L. Jacobsmeier, and Jeffrey Milyo. 2007. "Estimating the impact of state policies and institutions with mixed-level data." *State Politics & Policy Quarterly* 7(4): 446-459.
    - McCulloch, J.H. 1985. "Miscellanea on Heteros*edasticity." *Econometrica* 53(2): 483.
  - Recommended Readings:
    - Kennedy, Chapter 8
  - Assignments:
    - Problem Set 3 Due
    - Problem Set 4 Assigned

- **Mar. 14: NO CLASS–Spring Break**

- **Week 10 (Mar. 21): Collinearity**
  - Required Readings:
    - Fox Chapter 13
  - Recommended Readings:
    - Kennedy, Chapter 12
  - Assignments:
    - Problem Set 4 Due

- **Week 11 (Mar. 28): Residuals, Outliers, and Diagnostics**
  - Required Readings:
    - Fox Chapter 11
  - Recommended Readings:
    - Kennedy, Chapters 7 & 11
  - Assignments:
    - Paper Draft Due
- **Week 12 (Apr. 4): Generalized Linear Models: A Brief Intro**
  - Required Readings:
    - Fox Chapter 15
    - Gill, Jeff. 2001. *Generalized Linear Models.* Thousand Oaks, CA: SAGE. (This is another of the "Little Green Books" available for free through the GSU Library's subscription to Sage Research Methods.)
  - Recommended Readings:
    - None
  - Assignments:
    - Reviews Due
- **Week 13 (Apr. 11): Catch-Up**
- **Week 14 (Apr. 18): Student Presentations**
  - Required Readings:
    - None
  - Recommended Readings:
    - None
  - Assignments:
    - Final Paper Due
    - Memo Due
    - Final Exam Distributed (tentatively)