PS 2010 FOUNDATIONS OF QUANTITATIVE METHODS

Fall 2023

Instructor:	Qing Chang	**Time:**	Tu 9:00 – 11:30
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Course Description: This course provides basic mathematical and statistical foundations for students to do more advanced formal theoretical and quantitative empirical research in political science. Through hands-on exercises and real-world examples, students will learn the tools necessary to analyze and interpret political phenomena through empirical data analysis. This class divides into three modules. The first module covers essential mathematical tools, such as calculus, optimization, and algebra. The second module introduces various statistical concepts, probability theory, and logic of inference. The third module introduces linear regression, which combines all the knowledge learned from the first two modules.

Throughout this course, we will delve into both the theoretical foundations and practical application of statistics. This will involve exploring crucial theorems as well as acquiring the skills to analyze real-world data effectively.

Objectives:

- familiarize students with the benefits of using models for theoretical and empirical research in political science
- to prepare students for game theory, causal inference and advanced methods courses
- to introduce students to the R software

Grading Policy: Each homework assignment is worth 5% of your grade (50% total). The midterm and final exam are worth 20% each (40% total) and attendance is worth 10%. Grades follow the usual scale (93-100: A, 90-92: A-, 87-89: B+, 83-86: B, 80-82: B-, etc.).

Weekly Assignments: There will be weekly homework assignments starting from Week 2. You will have one week to complete each assignment. Assignment due at the following week before the class and you can submit your work through Canvas. New assignment and answer sheet of last week's assignment will be posted on my website immediately after each week's class. There will be ten homework assignments in total. I prefer typed answer with Latex or Word. However, hand-written answer with a scanned PDF format will be also acceptable. When you submit the hand-written one, please put all the pages of each week's assignment into a single file. Late assignments will be penalized by 10%.

All assignments include exercises that help you to solidify your understanding of concepts, definitions, and techniques. Meanwhile, it includes one or two computational questions that should be done in R. Collaborating in small groups of 2-3 on the assignments is permissible but you must acknowledge all people who you worked with and everyone must have a fully separate write-up. Assignments with identical code or answers is not acceptable.

Midterm and Final Exam: We will have in-class midterm and final exams during Weeks 7 & 14 respectively. The goal of these exams is to evaluate the cumulative knowledge and skills that the students learn from a series of lectures and practice. The format of the exams will not be so much different from that of the weekly assignments, except there will be no computational questions. However, the exams will include problems relevant to different topics of the previous weeks. All exams are open-book exams and I will provide you the necessary materials to answer the questions.

Course Pages:

1. https://canvas.pitt.edu/ for uploading your assignments.
2. https://qingcchang.com/courses/ps2010/ for course materials and assignments.

Requirements:

Software: Our main programming language for the purpose of this course will be the R programming language. Before our first meeting, you should install the following latest version software on your computer:

- R, you can download from: https://www.r-project.org/.
- RStudio Desktop Free version, you can download from https://www.rstudio.com/products/rstudio/download/.

Textbooks: There is only one required textbook for this class, the rest of them listed below are optional. Meanwhile, I will post all class handouts on our course website.

- **Required:** Moore, Will H. and David A. Siegel. 2013. A Mathematics Course for Political & Social Research. Princeton University Press. (short as MS)
- Wackerly, Dennis. William Mendenhall, and Richard Scheaffer. 2008. Mathematical Statistics with Applications, 7th edition. Brooks/Cole Cengage Learning. (short as WMS)
- Wickham, H. and Grolemund, G., 2016. R for Data Science: import, tidy, transform, visualize, and model data. O'Reilly.

Recitation/Office Hours: In addition to regular office hours, I will schedule an hour **recitation** every Friday between 8:30-9:45 at Posvar 4801, where we can work through additional examples, practice problems, and provide appropriate hints for the homework. This additional class time is **optional**, which means that your absence of the recitation will not be reflected in your participation grades. It can be very useful for you to attend, but you are in no way compelled to do so. If you need additional assistance, I am also available by appointment.

Tentative Course Outline:

Note: I certainly won't expect you to read all and understand every technical details when you do the readings. In fact, you just need to familiarize yourself with these materials, and it is great to bring your questions to class.

- Week 1 08/29 Introduction MS, Chapters 3
- Week 2 09/05 Derivatives MS, Chapters 5, 6
- Week 3 09/12 Integrals MS, Chapter 7
- Week 4 09/19 Intro to Probability MS, Chapter 9
- Week 5 09/26 Random Variable 1 MS, Chapters 10-11
- Week 6 10/03 **MIDTERM EXAM**
- Week 7 10/10 Random Variable 2
- Week 8 10/17 Estimation and Inference 1 WMS Chapters 8-9

- Week 9 10/24 Estimation and Inference 2 WMS Chapter 10
- Week 10 10/31 Matrix Algebra 1 MS, Chapter 12, 13
- Week 11 11/07 Matrix Algebra 2 MS, Chapter 14
- Week 12 11/14 OLS I
- Week 13 11/21 **Thanksgiving, No Class**
- Week 14 11/28 OLS II
- Week 15 12/05 **FINAL EXAM**

Academic Honesty: I follow a zero-tolerance policy on all forms of academic dishonesty.

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators. To learn more about Academic Integrity, visit the Academic Integrity Guide for an overview of the topic. For hands-on practice, complete the Understanding and Avoiding Plagiarism tutorial. Being found guilty of academic dishonesty is a serious offense and may result in a failing grade for the assignment in question and possibly the entire course.

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