Intermediate Statistics for Health Service Researchers

HAD 5772
Winter 2025

Instructor: Alex Hoagland, Ph.D.
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Class time and location: Thursdays, 12:00pm to 2:00pm. **Room TBD**

Office hours: Book appointments at https://calendly.com/hoagland-office-hours.

- Thursdays and Fridays: 10:00am to 12:00pm (subject to change).
- All appointments are by Zoom unless arranged otherwise in advance.
- Please note that I typically respond to emails and other class communication during normal "business hours," and not on evenings, weekends, or holidays.

Course Description: This course is designed to provide introductory background in statistical thinking, and to prepare students in the following areas: data handling, cleaning, and visualization in R; correlation; confidence intervals and hypothesis testing; regression; and applications to health systems research. This course is preparatory for students planning to do quantitative research and pursue the quantitative methods courses offered at IHPME (5744 and 5746).

Course Objectives:
At the end of this course, students should be able to:

- Use the computer program R for data management, statistical exploration, and analysis.
- Demonstrate an understanding (both conceptual and practical) of analytical approaches.
- Identify and execute appropriate analytical approaches to address specific research questions and collected data.
- Understand, explain, and present analytical results.
- Interpret and critique analytical methods used in the cutting edge of quantitative health systems research.

Method of Instruction: There are lectures but the course is designed to foster a seminar atmosphere, with discussions of case studies showcasing applications of the discussed methodology. Course readings, including case studies, are assigned, and class participants are expected to have read these prior to class.

Evaluation Criteria

- Assignments: 6 group assignments, collectively worth 60% of the final grade.
- Final Project: One group project, worth 40% of the final grade.

Assignment: There are 6 assignments, which can be completed in groups of 2-5, although each individual must make their own submission. The purpose of each assignment is for you to demonstrate that you can perform the analyses covered in this course and interpret the

results. Late assignments will be **discounted by 10 percentage points per day late.** No assignments will be dropped from the grade barring exceptional circumstances.

Final project: The project provides students with an opportunity to undertake an investigation of a research question of their own choosing on a self-contained topic within the fields of health economics or health services research. Writing will also help with communication skills and familiarization with the structure of policy briefs. **Students are expected to pair up in groups of no more than five (and no less than two) for their projects.**

To find data for the project, I recommend using publicly available data: a primer on where to look can be found here. For example, there are public use files for the Canadian Community Health Survey (CCHS). Other health related surveys can be downloaded at CHASS (https://datacentre.chass.utoronto.ca/) We will discuss these options more in class. Assignment details and a rubric are provided on the GitHub repository. **Final projects are due April 10.**

Grading scale: Courses taken for graduate credit are assigned a letter grade according to the School of Graduate Studies usage as follows:

Letter Grade	Grade Meaning	Numerical Marks (%)
A+	Excellent	90%-100%
A		85%-89.9%
A-		80%-84.9%
B+	Good	77%-79.9%
B		73%-76.9%
B-		70%-72.9%
FZ	Inadequate	0-69%

Note that while course grades may be collectively "curved," no individual grades will be rounded. Please do not ask me to round your grade, as this introduces inequity to other students, and does not come off well for a graduate student in a required methods course of a graduate degree.

Course website: This course has a GitHub repository that contains all relevant materials; you can access the repo at https://github.com/alex-hoagland/HAD5772.

Suggested textbooks: Our lectures are self-contained, but I recommend readings from (and frequently incorporate lecture material from) the following textbooks:

- *Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking* (Harvey Motulsky 2010).
- *The Effect,* Nick Huntington-Klein. (This one is free online!)
- Statistical Inference, 2002 (Casella and Berger)
- Regression and Other Stories: https://avehtari.github.io/ROS-Examples/

Statement on Generative AI in Course Content and Materials: Students may use artificial intelligence tools, including generative AI and Github Copilot, in this course as learning aids or to help produce assignments. However, students are ultimately accountable for the work they submit, and should document for each assignment in an appendix how these tools were used. The documentation should include what tool(s) were used, how they were used, and how the results from the AI were incorporated into the submitted work.

Course Schedule

Session #	Date	**Lecture / Readings**	**Exercise Due Dates**
1	Jan. 9	Introduction • HK, Introduction + Chapters 1-2 • Motulsky, Chapters 1-3	
2	Jan. 16	Programming in R + Descriptive Statistics • HK, Chapters 3-4	
3	Jan. 23	Visualizing data + Research Designs • Motulsky, Chapters 7-9; 32 • HK, Chapters 5-7	Assignment 1 due
4	Jan. 30	Measuring uncertainty I: standard errors + confidence intervals • Motulsky, Chapters 4-6 (emphasis on 4)	
5	Feb. 6	Measuring uncertainty II/Hypothesis Testing I: Statistical Significance • Motulsky, Chapters 12-14 • Additional reading: Chapters 10-11	Assignment 2 due
6	Feb. 13	Hypothesis Testing II: *p*-values and Practical Applications • Motulsky, Chapter 16-17	
	Feb. 17-21	**No class – Winter Reading Week**	Assignment 3 due, Feb. 21
7	Feb. 27	Linear Regression I: Bivariate Regression Models Motulsky, Chapters 33-35	
	Feb. 28	**Deadline to drop without academic penalty**	
8	Mar. 6	Applications I: RCT Evaluations	Assignment 4 due
9	Mar. 13	Linear Regression II: Multivariate Regression + Applications Motulsky, Chapters 37-38	
10	Mar. 20	Linear Regression III: Causality and Model-based Inference • Notes on DAGs, Moderation/Mediation, and Bad Controls • **Paper**: Dayan, N., et al. (2019). "Infertility treatment and risk of severe maternal morbidity: a propensity score–matched cohort study." *CMAJ, 191*(5), E118-E127.	Assignment 5 due
11	Mar. 27	Applications II: Survival Analysis and Mixed Methods • **Paper**: Bohm, E., Loucks, L., Wittmeier, K., Lix, L. M., & Oppenheimer, L. (2015). "Reduced time to surgery improves mortality and length of stay following hip fracture: results from an intervention study in a Canadian health authority." *Canadian Journal of Surgery, 58*(4), 257. • **Paper**: Hansen, N., Jensen, K., MacNiven, I., Pollock, N., D'Hont, T., & Chatwood, S. (2021). "Exploring the impact of rural health system factors on physician burnout: a mixed-methods study in Northern Canada." *BMC health services research, 21*(1), 1-10.	
12	Apr. 3	Final project presentations	Assignment 6 due
	Apr. 10		Final project due