**HAP 823: Causal Analysis & Comparative Effectiveness**

**Department of Health Administration & Policy**

**College of Public Health**

**George Mason University**

**Course Description**

Apply knowledge of discovery and data science methods to create network models of health data to predict population and public health outcomes. Analyze massive, high-dimensional data, using repeated and chained LASSO regressions, to create Causal Networks, and understand competing effects of multiple causes and mediators.

**Pre-Requisites**

This course assumes you know, and can do, regression (HAP 719) and Standard Query Language (HAP 671). *These topics are not taught but are expected*.

# Course Objectives

Upon completion of the course, students will be able to:

1. Create a counterfactual framework for causal analysis for observational health data.
2. Develop a network statistical model using repeated measures, chained equations, and LASSO regressions
3. Compare LASSO regression and Markov blankets in controlling confounding.
4. Isolate causal effects by closing backdoor pathways and adjusting for confounders in observational health data.
5. Evaluate multiple mediation effects by manipulating structure of network models.

# Required Textbooks

*Statistical Analysis of Electronic Health Records* by Farrokh Alemi, 2020.

*Causal Inference in Statistics: A Primer*, Judea Pearl, Madelyn Glymour, Nicholas P Jewell, 2016

# Pedagogical Approach

Each class will consist of four parts:

1. **Learn one:** instructor provides didactic lectures
   * Brief lectures of 10-15 minutes per module
   * Extensive online resources
   * Interactive lectures requiring active student participation
   * Q&A using text
2. **Do one:** practical laboratory work within each lecture.
   * Complete assignments during class time
   * Work in groups
   * Work on real datasets
3. **Teach one:** Students teach the topic they have learned to one another.
   * All assignments are done individually but with help from others. The students who are most helpful will receive a bonus grade increase.
4. **Evaluation**
   * Students evaluate each lecture, not just at end of the course
   * Students work individually but they can get help from each other. In this context, help means (1) giving advice on how to proceed, (2) checking that you have the same answer as other team members, but not (3) copying code from each other.

# Q&A on Text

You are invited to ask and receive answers on text. Questions asked are answered so all students can receive the answer. Answers typically include videos.

**LinkedIn ®**

You are encouraged to maintain a LinkedIn ® presence and connect with the instructor. Through the instructor’s page, you can find other alumni of the program/course. The instructor can endorse your skills. You can find job postings.

# Teach One Assignment

We rely on a method typically used in training of medical residents: "Learn one, do one, teach one." Each student is expected to not only learn the concepts in the course, and do the assignments, but also teach a portion of the course. This active participation in teaching helps students learn the concepts in the course in more depth. The best way to learn a topic is to teach it. Students are expected to teach by preparing a brief video. The steps to follow are:

1. Select which topic you wish to teach. Typically, students teach about an assignment in the week's topic. The teach one selection is done in first day of class.
2. A week prior to class lecture complete the assignments.
3. During class time, help students assigned to you to get started on the assignments
4. After class time, contact students assigned to you to see if they have run into a problem.
5. Provide a provisional pass/fail grade for student assigned to you.

Following tools are needed for preparing an optional online presentation:

1. A microphone is necessary to narrate your slides. Please do not rely on built in microphones for portable computers.
2. You can capture screen shots and insert it into your slide presentation using Command and Print Screen keys. [MAC Users►](http://graphicssoft.about.com/od/screencapturemac/ht/macscreenshot.htm)
3. Narrate your slides or use other video making software. [Narrate►](http://openonlinecourses.com/decisionanalysis/Presentations/Narrating_Media/Narrating.swf)
4. Convert the narrated slides to a video format that can be uploaded to the web. In later versions of Microsoft Power Point you can do so by saving the file to MP4 format.
5. Upload your narrated slides [Author Stream►](http://www.authorstream.com/) [You-Tube►](https://www.youtube.com/watch?v=fTda5Ypv9U0)
   * Share your narrated slides publicly so all students in the class can view it.
   * Put within the description the following statement: "This presentation was prepared as part of the HAP 823 course on Comparative Effectiveness taught by Farrokh Alemi, Ph.D. at George Mason University Department of Health Administration and Policy." Add a sentence about yourself to the

description. Keep in mind that the work you are uploading will remain on the web for years to come and will help shape your career. Maintain a professional attitude and presentation.

* + If you wish to be exempted from sharing your work publicly, make a request to the instructor with your justification and alternative plans. You can post publicly without disclosing your name. You are also allowed to remove your video after class. If you object to having your recorded voice on You tube, you should ask for exemption. Exempted individuals are asked to go through same steps (i.e. narrate slides, save as a movie, compress video file) but not have public display. They would distribute the compressed video through email to other students.

1. Email your URL to all the students in the course and the instructor.

**Principles of Effective Video Presentations**

1. Explain the topic from different perspectives.
2. Make sure your presentation is accurate.
3. Explain each step in the process and do not jump over what may seem trivial.
4. Have a consistent style (the same font, capitalization policy, color, and size throughout the video.
5. Make one, and only one, point per slide.
6. Use little text, just enough so the reader can follow your narrated comments. Two or three words should replace entire sentences. Your narration will provide the sentences needed.
7. Make sure all texts on slides are readable, even after compression to fit the video requirements. A U-tube video reduces Power Point slides to 1/4 of their original

size. Phone views have additional reductions. Font size should be larger than 24 points.

1. Make sure the narration is continuous. Do not record each slide separately and assemble them into a presentation. Instead narrate from start to the end at one sitting.
2. Narrate clearly. Use head-mounted microphones. Occasional hiccups are ok, keep them; they add color. Set compression levels high enough to be understood in a noisy room.
3. Be brief. Do not exceed 10 minutes. If you need more time, make multiple videos.

# Students' Evaluation

1. **Teach One Assignment (25%):** The Teach One assignment must be completed one week ahead of the related lecture. Missing this deadline reduces the Teach One grade by 20%. The URL for the Teach One assignment must be emailed to all students including the instructor on the day of lecture.
2. **Weekly Assignments (25%):** You are required to complete all assignments one week after end of lecture on the topic. Late assignments are accepted. Late assignments will receive 20% less grade. All assignments must be completed with an additional

student. No two students should work on more than one assignment together. Working together means discussing the assignment, showing how to solve the assignment and verifying that you have exactly same answers. It does not mean that one person does one part and the other another part. Do not copy code or work from each other. Each person hands in the entire assignment and lists the names of team members.

1. **Post Midterm Exam (25%):** The midterm is completed in class. Exam is similar to assignments and involve same problem sets with minor changes.
2. **Final Paper and Project (25%):** Students are expected to complete a multiple mediation analysis within All of Us data. Reports on portions of the final projects must be submitted at designated intervals throughout the course.

**University grading policies are followed.**

|  |  |  |
| --- | --- | --- |
| A | 4.00 | 94-100% |
| A- | 3.67 | 90-93% |
| B+ | 3.33 | 87-89% |
| B | 3.00 | 83-86% |
| B- | 2.67 | 80-82% |
| C | 2.00 | 70-79% |
| F |  | 69% and below |

# Topical Outline

Please note that course syllabus may change at any time prior to the date of the lecture. Do not print ahead of schedule. Check this page regularly for updates. Assignments are due within 7 days of date of topic, unless otherwise noted.

1. [**Preliminaries**](http://openonlinecourses.com/causalanalysis/CausalNetworks.html)
2. [**Markov Blanket**](http://openonlinecourses.com/causalanalysis/Markov%20Blanket.html)
3. [**Do Operation**](http://openonlinecourses.com/causalanalysis/Do%20Operation.html)
4. [**LASSO Regression**](http://openonlinecourses.com/causalanalysis/LASSO.html)
5. [**Temporal Analysis**](http://openonlinecourses.com/causalanalysis/TemporalAnalysis.html)
6. [**Regression Networks**](http://openonlinecourses.com/causalanalysis/CausalNetworksLASSORegression.html)
7. **Mediation**
8. **Midterm exam**
9. [**All of Us Project**](http://openonlinecourses.com/causalanalysis/AllofUsProject.html)
10. [**Diabetes**](http://openonlinecourses.com/causalanalysis/DiabetesPart2.html)
11. [**COVID-19**](http://openonlinecourses.com/causalanalysis/CovidSymptoms.html)
12. **Vaccination**

Midterm exam is take-home, timed, with open access to Internet and course web pages.

# Honor code

“To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this honor code: Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work” (George Mason University Catalog, 2006-2007, p. 31).

# Individuals with Disabilities

George Mason University is committed to complying with the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 by providing reasonable accommodations for disabled applicants for admission, students, applicants for employment, employees, and visitors.

Applicants for admission and students requiring specific accommodations for a disability should contact the Disability Resource Center at 703-993-2474, or the Equity Office at 703-993-8730.

Applicants for employment and employees should contact Human Resources at 703-993-2600 or the Equity Office. Students are responsible for providing appropriate documentation and requesting reasonable accommodation in a timely manner (George Mason University Catalog).

# Working E-Mail & Tweeter Accounts

All communications are facilitated by email and tweeter. Students must be able to receive emails and to regularly, at least daily, review emails. Do not allow the mailbox to become full. Tweeter or texting is used for quick responses.

# Instructor

This course was organized by Farrokh Alemi. Recent publication of Dr. Alemi are available on the web. You are encouraged to text Dr. Alemi between 9 am to 9 pm.