Quantitative Reasoning 170
First-Year Seminar: Causation
Fall 2013

Instructor: Cassandra Pattanayak, cpattanayak@wellesley.edu
Office: Clapp 238
Office Hours: Tue 2:40-4 and Wed 2:15-3:30 (unless announced otherwise)
and by appointment

Class Meetings: Tue and Fri 1:30-2:40, Science Center 256

Description: Do you believe that smoking causes lung cancer? What evidence justifies your belief? When lawyers provide free services to indigent clients, are those clients better off? Is online education effective? Correlations are reported in the news every day. However, demonstrating that a phenomenon causes another phenomenon—or even asking a sensible causal question—is often difficult. This seminar introduces a framework for conceptualizing causal questions and statistical tools for addressing those questions. We will explore the development of randomized experiments in the early twentieth century, along with current methods for answering causal questions without randomizing. Examples will come from fields such as medicine, public policy, law, education, and psychology.

Over the semester, each student pair will propose, design, and conduct a study that estimates causal effects in an area of the students' interest. Each project will involve both written and oral assignments spread throughout the course. In addition, short problem solving exercises and readings will be assigned. We will also follow and assess media reports throughout the semester. At class meetings, we will introduce new concepts, discuss readings, and follow the progress of student projects.

Goals: You should leave this course with the ability to critique studies encountered in your future classes or the media, along with statistical tools for designing and analyzing studies that demonstrate cause and effect. Assignments are also intended to refine written and oral communication skills.

Prerequisites: Fulfillment of the basic skills component of the Quantitative Reasoning requirement. No additional math or statistics background required.

Distributions: Mathematical modeling; QRF.

Quantitative Analysis Institute: This is the first for-credit course associated with Wellesley's new Quantitative Analysis Institute. The purpose of the QAI is to expand the role of statistics in teaching, learning, and research at Wellesley. I'm looking forward to incorporating your ideas as the institute is launched.

Accommodations: If you have documentation from Disability Services or anticipate conflicts with the course due to religious observance or a Wellesley-sponsored activity (such as an athletic team), please let me know early in the semester so that arrangements can be made.

Course Website: I will use Sakai (sakai.wellesley.edu) to post readings, assignments, and announcements.

Email: You will be automatically subscribed to the course google group (QR-170-01-FA13@wellesley.edu). I will use the google group for announcements, and you should feel free to use it to communicate with each other.

You can also email me personally. I will make every attempt to answer your emails within 24 hours. It is not always possible for me to answer last-minute questions just before a deadline.

My experience is that the concepts in this course are best explained in person. I strongly encourage you to take advantage of office hours, and I look forward to discussing the concepts and getting to know all of you!

Honor Code and Collaboration Policy: The Honor Code will be strictly enforced. Sources must be cited in written or oral assignments. Except for the critical review, project components will be conducted in pairs. Feel free to discuss project components and mini-assignments with your classmates. You are encouraged to (orally) discuss the short exercises with your classmates, but each student must write up solutions separately. Be sure that you have worked through each problem yourself and that the answers you submit are the results of your own efforts. For exercises and projects, you also may not share or view another student's computer code, submit output from another student's computer session, or allow another student to view your code or output. A good rule of thumb: if a fellow student asks you if you would like to discuss a problem on the short exercises, you are encouraged to say "yes"; if a fellow student asks to see your answer to a problem or code, the answer is "no." You are expected to explicitly acknowledge collaborators by writing their names at the top of your short exercises.

Laptop/Phone Policy: I expect that you will actively engage in class meetings. This means that laptops are used only for note-taking or other class exercises and phones are put away. My own experience is that it is easier to take notes by hand in a quantitative class, perhaps photographing or scanning your notes afterward for storage.

Readings: There is no textbook for this course. Readings will be posted on the course website or on reserve at the library, as needed.

Computing: Most of the assignments in this course will not involve data analysis software. I will introduce the free software R as a way to conduct statistical tests.

Grading: This course is mandatory credit/non-credit. We will use shadow grading, which means that grades will be calculated as in a letter-graded class, but these letter grades will not appear on any transcripts. Grades will be calculated based on the percentages indicated below. You will receive credit if your shadow grade is a C or above. Extensions will be granted only in exceptional circumstances such as serious illness or a family emergency, or to accommodate special circumstances as described on the previous page. If you think you may not be able to turn in an assignment at the deadline due to travel or other circumstances, submit it early.

Course Requirements and Grading Percentages:

Project (40%): The project will be conducted in pairs (assuming an even number of students). Components of the project will be completed throughout the semester:

Critical review of publication related to your project topic (10%) (written individually)

Study design (20%) (written and oral, both in pairs)

Outcome analysis and results (10%) (written in pairs)

Details on each of these assignments will be distributed and discussed. Written project components should be submitted through the course website by 10 pm on the indicated date, unless otherwise indicated. Assignments received within 24 hours after the deadline will receive 50% credit; assignments received more than 24 hours after the deadline will not be accepted.

Midterm Quiz (15%): There will be a closed-book midterm quiz in class on Fri, Oct 4. The midterm quiz will be held only on the specified date; there will be no make-up exams. There will not be an exam during the final exam period.

Short exercises (35%): Six short problem sets will be assigned throughout the semester. The purpose of these exercises is for you to gain experience applying the concepts discussed in class. These exercises should be submitted through the course website by 10 pm on the indicated date, unless otherwise indicated. Exercises received within 24 hours after the deadline will receive 50% credit; exercises received more than 24 hours after the deadline will not be accepted.

Mini-Assignments (5%): Throughout the semester, I will ask you to find examples in the news or gather your thoughts on a particular issue in order to motivate discussion at the next class. I may also ask you to informally present your example to the class. These mini-assignments will be graded credit/non-credit, and you may drop one. Mini-assignment deadlines are not included in the course outline below.

Active Participation (5%): You are expected to attend class meetings, actively engage during lectures and activities, and participate in discussions.

Course Outline (subject to change) and Deadlines

		Topic	Due
Week 1	Tue, Sept 3 Fri, Sep 6	Introduction to the Causal Framework	
Week 2	Tue, Sep 10 Fri, Sep 13	Components of the Causal Framework	Exercise 1 (Th, Sep 12)
Week 3	Tue, Sep 17 Fri, Sep 20	Assignment mechanisms	Exercise 2 and Project Topic Proposal (Th, Sep 19)
Week 4	Tue, Sep 24 Fri, Sep 27	Simple randomized experiments	Critical review proposal (Th, Sep 26)
Week 5	Tue, Oct 1 Fri, Oct 4	Fisher's approach	Midterm Quiz (Fri, Oct 4)
Week 6	Tue, Oct 8 Fri, Oct 11	Neyman's approach Imputation-based inference	Exercise 3 (Th, Oct 10)
Week 7	*No class Oct 14 (Fall break)* Fri, Oct 18	Complex experiments	Exercise 4 (Fri, Oct 18)
Week 8	Tue, Oct 22 Fri, Oct 25	Observational studies	Critical review (Th, Oct 24)
Week 9	*No class Oct 29 (Tanner Conference)* Fri, Nov 1	Matching	
Week 10	Tue, Nov 5 Fri, Nov 8	Matching and subclassification	Project design write-up (Th, Nov 7)
Week 11	Tue, Nov 12 Fri, Nov 15	Subclassification Non-compliance	Exercise 5 (Th, Nov 14)
Week 12	Tue, Nov 19 Fri, Nov 22		Project design presentations (in class)
Week 13	Tue, Nov 26 *No class Nov 29 (Thanksgiving)*	Parallel experiments and observational studies	
Week 14	Tue, Dec 3 Fri, Dec 6	Principal stratification	Exercise 6 (Th, Dec 5)
Week 15	Tue, Dec 10	Conclusion	Draft results paper (Mon, Dec 9)
Finals Period			Results paper (Fri, Dec 20)