

Econ 626 – Experimentation and Causal Inference Summer 2021
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Professor: Evan Bloom	Meeting day(s) and time: Mondays 6:00-10:30 PM (May 24- June 28) <i>Note: A make up class on Wednesday June 2 (same time) to avoid Memorial Day on May 31</i>
Office hours: Wednesdays 12:00 - 1:00 PM Thursdays 5:00- 6:00 PM	Meeting location:
Instructor contact info: ebloom4@usfca.edu	Number of units: 2

Course description

At digital companies, experiments are an important tool to push forward innovation. Companies use experiments (usually referred to as A/B-Tests) as ways to understand their users, roll-out new products or features, and to inform decision making. Other organizations, such as governments or non-profits also increasingly rely on experimentation for policy evaluation.

Economists and Data Scientists often contribute to many phases of experimentation: proposing hypotheses, implementation, analyzing results and interpretation to inform decisions. This course is designed to help students gain competency in the practical, analytic, and technical skills they will need to contribute. Students will read about experiments implemented at digital companies and other organizations, learn to create materials to prepare for each phase of an experiment, and practice the analytical techniques that pair with them.

What students can expect to learn in the course (learning outcomes)

Students should learn the following by completing the course:

- *How to identify business, technology, and policy problems that can be addressed by experimentation:* Experiments are one tool used to inform decisions. With expertise in microeconomic and utility theory, economists are well-positioned to make rigorous predictions about the effects of an intervention. This leads them to identify questions that can be well-informed with properly designed experiments. Students should leave this class with an appreciation for the

breadth of business and policy problems that can be addressed and the value of experimentation to answer these questions.

- *How to formulate, design, and analyze experiments for decision-making.* An economist on a data science team will have responsibilities during many phases of an experiment. Students should leave this class with an understanding of these phases and some hands-on experience at some of the tasks that would be required. This includes experience working with data sets and knowledge of statistical techniques to prepare and analyze results.
- *How to communicate the design and results of an experiment with a broad set of stakeholders.* Economists are often part of cross-functional teams with many partners that implement experiments and stakeholders that consume the knowledge they produce. Many times, economists are not ultimately responsible for the decision-making after an experiment. Students should gain experience with the types of deliverables that would help them communicate outwards to build alignment and credibility on the research design to influence decisions in an organization.
- *How to think critically about the causality for decision-making.* Organizations often make decisions from many sources of data and information. Students should build an appreciation of the value of causally identified data and be able to think critically about the validity of the claims made by the data. This will enable students to understand when an experiment may or may not be a valid way to learn.
- *How to anticipate and balance some of the tradeoffs that occur when running experiments.* There is rarely a perfect way to run an experiment. Economists are well positioned to help organizations understand what will and won't be learned from different designs of different experiments. Students should understand where some key decision points will occur and have opportunities to think through how to respond.

Each of these learning outcomes will be assessed by a combination of group projects and individual problem sets.

Admission and Pre-requisites

This course is designed for economics graduate students who already have basic programming skills. Undergraduates or students from other departments may attend, subject to space availability and permission of the instructor. Permission is unlikely to be granted to students who have not already taken at least one course in programming, in calculus, in econometrics, and in microeconomics, receiving a B+ or better in each.

Technical Requirements

Weekly problem sets will be assigned in an Jupyter Notebook, using Python. Students may complete coursework in either Python or R, but solutions and hints will primarily be provided in Python. Python is recommended.

Course Structure

The 6-week course will be structured around various phases of an experiment:

1. Designing and Planning (2- sessions)
2. Implementation
3. Analysis (2- sessions)
4. Informing Decisions

Students will come to class having read a pre-assigned paper or article about an experiment. Students should come prepared to discuss.

Each class will begin with a practicum on the business, organization, and technological considerations that go into this phase of an experiment. In groups, students will begin preparing a business deliverable (usually in the form of a written memo) that would address these considerations. These case-study deliverables will be completed, as a group, before the next class for evaluation.

The second half of each session will go deeper into the statistical methodologies for an economist to deliver technical output during each phase of an experiment. We will have a lecture describing techniques and methodologies. Students will have a coding problem set, for them to practice these techniques. Each student will deliver their own results as a problem set (generally in the form of a Jupyter Notebook), before the next class for evaluation.

Grading

The course will be graded based on the following components:

45%	Coding Problem Sets
45%	Group Case-Study Deliverables
10%	Participation in discussions

Attendance

Attendance is required, as students will begin group work during class. Students will lose approximately 10% of the total grade for each session missed . This deduction reflects zero participation points for a missed class and zero points group case study as a student cannot meaningfully contribute to the group work.

Note: We have a make up class on Wednesday June 2, to avoid Memorial Day. Due to the odd schedule, I will make accommodations if a student needs to miss this session, so long as they alert me 1 week in advance.

Assignments

Assignments will consist of a mix of individual problem sets and group case-studies. A case-study and a problem set will be assigned in each session. They are to be turned in before the start of the next class session. Late homework assignments can be submitted within 7 days of the original due date but will receive a 50% penalty. After 7 days late assignments will receive a zero (0) grade.

Extra Credit

I will NOT provide “special projects” or other individual extra credit plans, so don’t ask. Any extra credit opportunities will be available to all students.

Grading breakdown and grading policies

A	93%+
A-	90% - 92.99%
B+	87% - 89.99%
B	83% - 86.99%
B-	80% - 82.99%
C+	77% - 79.99%
C	70% - 76.99%
D	60% - 69.99%
F	< 60%

Complaints

Complaints should be addressed to the grader; complaints must be in writing unless it is something simple like adding points or a missing grade in an exercise. All petitions must be delivered in person to me in the first class after the assignment’s due date.

Readings:

Students should be prepared by reading the assigned paper in advance of each class. Links to the papers are included in the syllabus

There are two primary textbooks for this class. Both are available online and linked here:

- [*Causal Inference: The Mixtape* by Scott Cunningham \(Mixtape\)](#)
- [*Understanding Statistics and Experimental Design; How to Not Lie with Statistics* by Michael H. Herzog, Gregory Francis, Aaron Clarke \(HFC\)](#)

There is one supplementary textbook, found here:

- [*Handbook of Field Experiments, Volume 1* Esther Duflo Abhijit Banerjee](#)

I highly recommend reading the following book during the course. It is an easily read popular take on the types of experiments we will discuss in class. Some of the papers we will read appear in this book. With all the other reading, this is not required. Personally, I was able to read it over the course of 3-days and believe it will be worth the small investment.

- [*The Power of Experiments: Decision Making in a Data-Driven World* by Michael Luca , Max H. Bazerman](#)

Course Schedule

I will try to follow the schedule as much as possible, but I reserve the right to alter the timing and exact session content

Day (Required Reading)	Topics
Session 1: Designing an experiment (Building a culture of experimentation HBR)	Practicum: <ul style="list-style-type: none"> • Hypothesis Generation • Outcome Metrics • Decision Framework Methods: <ul style="list-style-type: none"> • Potential Outcomes • Average Treatment Effects • SUTVA <i>Mixtape: 119-174</i>
Session 2: Specifying the Experiment Reciprocity and Unveiling in Two-sided Reputation Systems: Evidence from an Experiment on Airbnb [focus on parts 1-7]	Practicum: <ul style="list-style-type: none"> • Cell Design • Allocation • Duration Methods: <ul style="list-style-type: none"> • Hypothesis testing • T-tests

	<ul style="list-style-type: none"> • Standard Errors, Confidence Interval p-value • Power Calculation <p><i>HFC: Chapter 3, 7</i></p>
Session 3: Running the Experiment Price Salience and Product Choice	<p>Practicum:</p> <ul style="list-style-type: none"> • Compliance • Monitoring • How to proceed when something goes wrong <p>Methods:</p> <ul style="list-style-type: none"> • Anomaly detection • Falsification tests • Peeking and the perils of early stopping <p><i>HFC: Chapter 10.4</i></p>
Session 4: Analyzing the Experiment Does Price Matter In Charitable Giving? Evidence from a Large-Scale Natural Field Experiment	<p>Practicum:</p> <ul style="list-style-type: none"> • Primary and Secondary Metrics • Statistical significance • Multiple cell comparisons <p>Methods:</p> <ul style="list-style-type: none"> • Regression • Linear probability model • Cuped <p><i>Mixtape: Chapter 1 (Pages 37-95)</i> <i>HFC: Chapter 5</i></p>
Session 5: Analyzing the Experiment (Part 2) Measuring Consumer Sensitivity to Audio Advertising: A Field Experiment on Pandora Internet Radio	<p>Practicum:</p> <ul style="list-style-type: none"> • Digging deeper • Understanding Mechanisms <p>Methods:</p> <ul style="list-style-type: none"> • Instrument Variables <ul style="list-style-type: none"> ○ Exclusion Restriction ○ Local Average Treatment Effect • Heterogeneous Treatment Effects <p><i>Mixtape: pages 96-118, 315-384</i> <i>HFC: pages 139-140</i></p>
Session 6: Informing decisions	<p>Practicum:</p>

<u>RANDHealth Insurance Experiment - 3 decades later</u>	<ul style="list-style-type: none"> ● Rollout ● Economic Value ● Intuition and insight <p>Methods:</p> <ul style="list-style-type: none"> ● Sensitivity Analysis ● “Envelope Math” <p>Special Topic:</p> <ul style="list-style-type: none"> ● <u>Ethics of Experimentation</u>
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Course Policies

Come Prepared

I come prepared, so I expect you to come prepared as well. You should have completed all reading and some homework assignments prior to lecture and be prepared to answer questions related to the material.

Group Work

You may cooperate with other students or work in small groups on problem sets. However, for problem sets each student must submit their own work individually. You are individually responsible for understanding the material.

Program Learning Outcomes

This course is a component of the MS Applied Economics. It will contribute to the following program learning outcomes:

PLO-1: Economic Data Manipulation: Students will be able to effectively use modern programming languages to clean, organize, query, summarize, visualize, and model large volumes and varieties of data.

PLO-2: Economic Data Analytics: Students will possess a theoretical and applied understanding of the use of econometrics and statistics for descriptive and causal inference.

PLO-4: Economic Problem Solving: Students will be able to solve real-world data-driven business and policy problems working with economists, policy makers, data scientists and business practitioners.

PLO-5: Economic Communication: Students will be able to communicate their research approach and findings at an excellent level, both in writing and verbally.

University-wide policies and legal declarations:

Students with Disabilities

If you are a student with a disability or disabling condition, or if you think you may have a disability, please contact USF Student Disability Services (SDS) at (415) 422-2613 within the first week of class, or immediately upon onset of disability, to speak with a disability specialist. If you are determined eligible for reasonable accommodations, please meet with your disability specialist so they can arrange to have your accommodation letter sent to me, and we will discuss your needs for this course. For more information, visit <http://www.usfca.edu/sds>.

Behavioral Expectations

All students are expected to behave in accordance with the Student Conduct Code and other University policies (see <http://www.usfca.edu/fogcutter/>). Students whose behavior is disruptive or who fail to comply with the instructor may be dismissed from the class for the remainder of the class period and may need to meet with the instructor or Dean prior to returning to the next class period. If necessary, referrals may also be made to the Student Conduct process for violations of the Student Conduct Code.

Academic Integrity

As a Jesuit institution committed to cura personalis -- the care and education of the whole person -- USF has an obligation to embody and foster the values of honesty and integrity. USF upholds the standards of honesty and integrity from all members of the academic community. All students are expected to know and adhere to the University's Honor Code. You can find the full text of the code online at <http://myusf.usfca.edu/academic-integrity/>. The policy covers:

- Plagiarism — intentionally or unintentionally representing the words or ideas of another person as your own; failure to properly cite references; manufacturing references.
- Working with another person when independent work is required.
- Submission of the same paper in more than one course without the specific permission of each instructor.
- Submitting a paper written by another person or obtained from the Internet.

Counseling and Psychological Services (CAPS)

CAPS' diverse staff offers brief individual, couple, and group counseling to student members of our community. CAPS services are confidential and free of charge. Call (415) 422-6352 for an initial consultation appointment. Telephone consultation through CAPS After Hours is available Monday - Friday from 5:00 p.m. to 8:30 a.m., 24 hours during weekends and holidays; call the above number and press 2. Further information can be found at <https://myusf.usfca.edu/student-health-safety/caps>.

Confidentiality, Mandatory Reporting, and Sexual Assault

As instructors, one of our responsibilities is to help create a safe learning environment on our campus. We also have a mandatory reporting responsibility related to our role as

faculty. We are required to share information regarding sexual misconduct or information about a crime that may have occurred on USF's campus with the University. Here are some useful resources related to sexual misconduct:

- To report any sexual misconduct, students may visit the Title IX coordinator (UC 5th floor) or see many other options by visiting usfca.edu/student_life/safer.
- Students may speak to someone confidentially or report a sexual assault confidentially by contacting Counseling and Psychological Services at (415) 422-6352.
- To find out more about reporting a sexual assault at USF, visit USFs Callisto website at: usfca.callistocampus.org.
- For an off-campus resource, contact San Francisco Women Against Rape (SFWAR) (415) 647-7273 (sfwar.org).