MKTG 309 and MKTG 809
Special Topics: Experiments for Business Decision Making
Prof. Elea McDonnell Feit
Fall 2016

Logistics
Tuesday and Thursday 10:30-12:00 from 8/30/206 through 12/8/2016
Room TBD
Course website TBD
Office hours by appointment

Course Goals
In the past decade, the shift of advertising dollars to measurable digital marketing channels has suddenly made tactical experiments an economically feasible way to inform marketing decisions such as how advertising should be designed and targeted, what types of promotions are most effective, what products should be offered, how sales staff should be compensated, which sales channels should be emphasized, etc. Many marketers engaged in online retailing, direct marketing, online advertising, media management, and service operations are rapidly embracing a "test and learn" philosophy and most digital marketing platforms now support rigorous field experiments. The rapid rise of the "test and learn" philosophy in marketing has created a huge demand for those who can design, field, and analyze experiments. Through this course, you will learn about, discuss and practice a wide range of critical skills for experimentation, from the statistical methods used to design and analyze experiments to the management and strategy required to execute an experiment and act on the results. Although our cases and examples will focus on marketing problems, the material covered can be applied in a number of other domains particularly operations, management and product design.

Course Approach
Creating an effective experiment, one that truly provides value to the organization, requires equal measures of creativity and technical skill. Consequently, this course will alternate lectures and homework exercises on statistical methods with case discussions, readings and guest lecturers that will expose you to broader managerial and strategy issues such as "How do we decide what we should test?" and "How do we minimize impact on the operations while still learning something from the test?" Although the course outline is structured around the statistical topics, I have designed the schedule so that each week will include discussions and exercises that emphasize creativity and intuition, as well as the statistical mechanics. Ultimately, my goal is for you to develop an understanding of the *interplay* between creativity and rigorous data analysis in business decision making. Through the assignments and discussions, you will develop and exercise your ability to frame ill-defined problems, determine what data and analysis might provide information about that problem, and examine the evidence for or against a particular business decision.

During the first part of the course, we will cover a number of experimental methods that are widely used in practice and that most marketers should be able to execute independently. You will develop a high level of hands-on skill with A/B testing, multivariate testing, regression and optimal design. Towards the end of the course, we will cover several more sophisticated methods including sequential testing and decision theory that are typically handled in practice by experts but are rapidly becoming more accessible through software.

Who should take this course?
For MKTG 309: This course is ideal for students with a background in statistics that covers hypothesis testing, ANOVA, and multiple regression (STAT 101, STAT 431, or equivalent). I will motivate statistical

material with concrete examples from marketing, so some experience with marketing (MKTG 101) or marketing research (MKTG 212) may also be helpful, **but is not necessary**. Students from engineering, business, math, and science are all encouraged to enroll. If you have any concerns about whether this course is appropriate for you, please don't hesitate to contact me. **The course has been approved to count toward undergraduate concentrations in Business Analytics & Statistics.**

For MKTG 809: This course is ideal for students with a background in statistics that covers hypothesis testing, ANOVA, and multiple regression (STAT 621 or equivalent). I will motivate statistical material with concrete examples from marketing, so some experience with marketing (MKTG 621/622) or marketing research (MKTG 756) may also be helpful, but is not necessary. If you have any concerns about whether this course is appropriate for you, please don't hesitate to contact me.

Textbook:
Because the application of experimental methods is relatively new in business, there are few textbooks that are suitable for business students. To fill this gap, I am writing a new book titled *Business Experiments* with Bruce D. McCullough, which is scheduled to go to print in 2017. I will provide draft copies of the book and I appreciate any feedback you have. Please note that this is a *draft;* there will be an award for the student who finds the most egregious typo.

Software:
The best software package for experimental design is JMP 12 and I will work all examples in R. JMP 12 is installed in all Wharton computer labs and can be accessed through the virtual lab. Student licenses can also be purchased for $20. Those who know R are encouraged to use R instead of JMP. The AlgDesign package in R replicates most of the experimental design functionality in JMP 12..

Other Recommended Books:
Many of our applications will involve digital analytics and so you may find Kaushik (2009) *Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity* a useful reference. If you are only going to have one book on digital marketing on your shelf, it is a great general reference on and it includes a nice chapter on A/B testing. There are also several popular books with more in-depth coverage of A/B testing which include lots of examples. My favorite is McFarland (2012) *Experiment! Website conversion rate optimization with A/B and multivariate testing*.

Since we will be using JMP, Goupy and Creighton (2007) *Introduction to Design of Experiments with JMP Examples*, provides more comprehensive treatment of the JMP modules than we can cover in class, but it is more directed at an engineering audience. I don't love the writing, but it might be a useful reference, if you plan to use JMP a lot.

For those of you who want more technical coverage of the design and analysis methods, the classic textbook on Design of Experiments is Montgomery (2008) *Design and Analysis of Experiments*.

Another book targeted at business students that I have used in the past is Ledolter and Swersey (2007), *Testing 1-2-3: Experimental Design with Applications in Marketing and Service Operations*. It has great cases (although some are a bit dated) and it has good coverage of the statistical methods.

Representative Readings and Cases:
Anderson, Eric and Duncan Simester (2011) "A Step-by-Step Guide to Smart Business Experiments:, *Harvard Business Review*.
Ariely, Dan (2010), "Why Businesses Don't Experiment," Harvard Business Review, April.

Christian, James, Eleanor McDonnell Feit and Mark A. Beltramo (2007) "Expert Feature: Conjoint Analysis at General Motors" in Feinberg, Kinnear and Taylor, *Modern Marketing Research: Methods and Cases*.

Davenport, Thomas (2009), "How to Design Smart Business Experiments," *Harvard Business Review*, February.

Fishman, Ray (2013) Did eBay Just Prove That Paid Search Ads Don't Work?, *Harvard Business Review Blog Post.*

Groupy, Jacques and Lee Creighton (2007*) Introduction to Design of Experiments with JMP Examples*, SAS Institute p 307-350.

JMP (2007), "JMP Design of Experiments"

Lambrecht, Anja and Catherine Tucker (2013) When does retargeting work? Information specificity in online advertising, *Journal of Marketing Researc*h, 50:5, 561-576.

(optional) Scott, Steven L. (2010) "A modern Bayesian look at the multi-armed bandit," *Applied Stochastic Models in Business and Industry*," 26, 639-658.

Venkatensan, Rajkumar and Paul W. Farris (2008) Advertising Experiments at the Ohio Art Company, *Harvard University Press*.

Course website:
I will use Canvas to handle all course logistics and paperwork, so that we can use class time to focus on the course content. Your readings and preparation for each class meeting will be posted in Canvas. Lecture slides will be posted to Canvas just before each class meeting. All graded assignments will be announced, turned in and graded via Canvas. If you have any issues accessing material in Canvas, please bring it up in class or e-mail me.

Classroom Manners:
One great advantage of taking a course that meets in a classroom is that we can rapidly build a community and I ask that you do your best to create an environment where we all can learn from each other. Asking questions or providing comments that help you and your classmates understand the material better is great. Eating or drinking is fine, so long as it isn't distracting to the rest of the class. Using electronics in a way that contributes to the learning environment is encouraged, and don't be surprised if I ask you to look something up or do a calculation for me. Personally, I find it very distracting when there are students in class who not engaged, so I would appreciate it if you would give your full attention to the class and avoid sleeping, checking e-mail, posting to social media, playing games, etc. during class. I promise not to act like a pre-recorded video and I would appreciate it if you would avoid treating me like one.

Assignments and Grading:
Designing experiments and analyzing the resulting data is a skill that must be practiced, and so assignments, midterm exams and a project are a critical components of this course. Sometimes I will give you textbook-style exercises designed to help you practice the mechanics of designing and analyzing experiments. Other times I will give you more open-ended tasks designed to help you learn the art of applying these methods in practice. These open-ended tasks will require you think broadly about business challenges and organizational context, in addition to working through the statistical mechanics. For instance, I may ask you to "Analyze at this data set and tell me what it says about the effectiveness of advertising." When I ask a question like this I expect you to provide me a write-up similar to what you might present to a decision-maker; it should succinctly describe the key business issues, provide supporting analysis and then conclude with a direct statement of the implications of the analysis for the business decision.

Homework assignments (25%)

Written homework assignments will be due weekly during the first part of the semester. Details of the assignments including due dates will be provided via the course website. You may discuss assignments with other students, but each student should write up his or her submission independently. All assignments will be submitted electronically through the course website. Late assignments are accepted up until the last day of class and will be marked down by 15%.

Midterm Exam I (20%)

The in-class, pencil-and-paper mid-term exam will cover research design and A/B testing and will combine short-answer, computational and essay questions.

Mid-term Exam II (20%)

The second mid-term exam will be similar in format to the first mid-term and will cover multivariate testing including factorial designs and optimal design.

Project (25%)

For the project, you will work in small groups to design, execute and analyze an experiment. Working with a business or non-profit organization, you will identify an opportunity for testing, design an experiment, field the experiment and analyze the results. Most projects involve communicating with potential customers via some marketing channel including e-mail, website, display advertising, social media or in-person. More details on the project will be distributed via the course website.

Participation (10%)

Active participation, particularly during case discussions, is expected. *Your contributions to the discussion will be evaluated based on how your questions or comments contribute to the learning of your classmates*. Grandstanding is discouraged.

Disabilities

In compliance with Penn policy and equal access laws, I am available to discuss academic accommodations that you may require as a student with a disability. Requests for academic accommodations need to be made during the first two weeks of the semester, except under unusual circumstances, to arrange reasonable accommodations. Students must register with Student Disabilities Services (SDS) for disability verification and for determination of reasonable academic accommodations. Even if you situation doesn't require a formal accommodations, I encourage you to discuss with me any special learning needs that you may have, so that I can work with you to make sure that you have the best possible learning experience. In many cases, I can make simple adjustments that will improve learning for the entire class. All such discussions will be confidential.

Academic Honesty

Academic honesty is fundamental to our class and the University community and I take issues related to academic honesty very seriously. Our University Code of Academic Integrity is posted at http://www.upenn.edu/academicintegrity/ and covers cheating, plagiarism, facilitating cheating and other attempts to gain unfair advantage. I expect that everyone in this course will familiarize themselves with and follow this code. Suspected violation of the Code in this course will be referred to the Office of Student Conduct.

Tentative Course Outline

Introduction (one week)
- Testing in the digital environment
- Experimentation versus observational data analysis

A/B Testing and Research Design (three weeks)
- Analyzing A/B experiments (hypothesis testing, sample size planning)
- Designing of A/B experiments (randomization, control conditions, internal and external validity)
- Tools for online testing
- Case: Experiments at the Ohio Art Company
- A/B/C/D experiments, ANOVA and blocking (tentative)
- Building a testing capability

Decision Theory
- When should you do an experiment?

Midterm Exam I

Multivariate Testing with Two-level Factors (two weeks)
- Review of regression
- Two-level full factorial experiments (L&S, Chapter 4)
- Two-level fractional factorial designs (L&S, Chapter 5)
- Cases: Eagle Brands & Magazine Price Test
- A/B and multivariate testing in practice

General Optimal Design (two weeks)
- Introduction to model building
- Optional design, information theory and D-optimal designs (L&S, Appendix 8.1, plus additional readings)
- Design of conjoint studies, i.e. multinomial logit studies, bayesian D-optimality

More Decision Theory (one week)
- More concepts from decision theory
- Sequential experiments & multi-armed bandits

Midterm Exam II

Experiments in Practice (three weeks)
- Guest lecture on integrating experiments into the organization
- Consulting on projects