

MKTG 3090 and MKTG 8090

## **Experiments for Business Decision Making**

Prof. Connor Campbell

Spring 2024 DRAFT

### **Logistics**

**Class meets** Monday and Wednesday 12:00-1:30 in Room **JMHH 355**. **No class on 1-17-24**

All readings and assignments posted on [Canvas](#)

Office hours: 2:00-3:00 Monday & Wednesday or by appointment

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### **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, people management and product design.

### **Course Approach**

Creating an effective experiment, one that truly provides value to the organization, requires equal measures of management 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 business acumen, 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?**

This course is ideal for students with a background in statistics that covers hypothesis testing, ANOVA, and multiple regression (STAT 101, STAT 431, STAT 621 or equivalent). I will motivate statistical material with concrete examples from marketing, so some experience with marketing (MKTG 101 or MKTG 621/622) or marketing analytics (MKTG 212 or MKTG 756) may also be helpful, *but is not necessary*. Students with backgrounds in 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 as an elective in the MBA and undergraduate concentrations in Business Analytics & Statistics.

### **Textbook:**

Because the application of experimental methods is relatively new in business, there are few textbooks that are suitable for business students. For the first part of the course, I will not be following any book closely and I may provide some draft chapters of a book I am writing on *Business Experiments* with Bruce D. McCullough. I will also be using some exercises from [Ledolter and Swersey \(2007\), \*Testing 1-2-3: Experimental Design with Applications in Marketing and Service Operations\*](#). During the second half of the course, I will follow Ledolter and Swersey more closely. I suggest you purchase a copy.

### **Software:**

For assignments, you may use any software that will do the job. Those who know [R](#) or python are encouraged to use those. The [AlgDesign](#) package in R may be particularly useful as will numpy, pandas, and scikit-learn should you choose to use python.

### **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 website 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\*](#).

## Readings and Cases:

- Almquist, Eic and Gordon Wyner (2001) Boost Your Marketing ROI with Expeirmental Design, *Harvard Business Review*
- 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.
- Benko, Jessica (2013) The Hyper-Efficient, Highly Scientific Scheme to Help the World's Poor, *Wired Magazine*.
- Blake, Thomas, Chris Nosko and Steven Tadelis (2015) "Consumer Heterogeneity and Paid Search Effectiveness: A Large-Scale Field Experiment}", *Econometrica*
- 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.
- Fisman, Ray (2013) Did eBay Just Prove That Paid Search Ads Don't Work?, *Harvard Business Review Blog Post*.
- Google (2015) Proving Marketing Impact: 3 Keys to Doing It Right, *Think With Google*.
- Google (2016) Inside Google Marketing: Applying a Research Mentality to Measurement, *Think With Google*.
- Groupy, Jacques and Lee Creighton (2007) *Introduction to Design of Experiments with JMP Examples*, SAS Institute p 307-350.
- Lambrecht, Anja and Catherine Tucker (2013) When does retargeting work? Information specificity in online advertising, *Journal of Marketing Research*, 50:5, 561-576.
- Lambrecht, Anja and Catherine Tucker (2015) Field Experiments in Marketing, working paper.
- Rush (2012) Optimization at the Obama Campaign, blog post.
- Scott, Steven L. (2010) "A modern Bayesian look at the multi-armed bandit," *Applied Stochastic Models in Business and Industry*, 26, 639-658.
- Scott, Steven L. (2014) "Multi-armed bandit experiments in the online service economy", *Applied Stochastic Models in Business and Industry*, 31, 1, 37-45.
- Tomke, Stefan and Jim Manzi (2014) The Discipline of Business Experimentation, *Harvard Business Review*.
- Vaver, and Jim Koehler (2011) Measuring Ad Effectiveness Using Geo Experiments, working paper.
- 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. All classes will be videoed and posted to Canvas. 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 your 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 (see course website for more specific dates)**

### ***Introduction (1 week)***

- Testing in the digital environment
- Experimentation versus observational data analysis

### ***A/B Testing and Research Design (4 weeks)***

- Analyzing A/B experiments (hypothesis testing, sample size planning)
- Guest Lecture on Website Testing
- Designing A/B experiments (randomization, control conditions, internal and external validity)
- Case: Experiments at the Ohio Art Company
- Advanced Analysis (Subgroups, A/B/C/D experiments, ANOVA, blocking)
- Small N Testing
- Guest Lecture on In-Store Testing

### ***Decision Theory (1 session)***

- When should you do an experiment?

### ***Midterm Exam I (1 session)***

### ***Multivariate Testing with Two-level Factors (2 ½ 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 (one week)***

- 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

### ***Advanced Topics (one week)***

- Sequential experiments & multi-armed bandits
- Decision theory for advertising response

### ***Midterm Exam II (one session)***

### ***Experiments in Practice (three weeks)***

- Guest lecture on integrating experiments into the organization
- Project presentations

