Overview

The purpose of the course is to introduce a selection of mathematical models in marketing. The topics it covers include social networks, mechanism design problems in marketing including auctions and matching, and applications of transformers, Markov decision processes and reinforcement learning to marketing. The emphasis of the course is on developing foundational skills for understanding and conducting mathematical research in marketing, with special attention to new and emerging research areas and methods.

Class sessions will combine lectures and discussions of assigned articles. You are expected to actively contribute to class discussions and think critically about the concepts and issues discussed in the course. Reading and analyzing papers for each class is the best way to prepare for class participation. You are expected to prepare a short critique (2-3 pages) and lead the class discussion for selected papers. Both your critique and class discussion should focus on providing:

1. A statement of the objective and contribution of the research.
2. A succinct summary of the model, estimation and/or optimization and the results;
3. A critique of the research, including the paper’s major strengths and weaknesses.
4. Future research questions suggested by the research.

Grading

25% homework; 25% research proposal; 25% final exam; 25% class preparation and presentations.

You should identify a research question by the fourth week of class, so that you have sufficient time to acquire the relevant background and sufficiently develop and present the research proposal by the last class of the term. The proposal should briefly review the
relevant literature, explicitly state the proposed contribution, develop a model, describe
the required data, and outline the analysis and expected results. The entire paper need
not be completed. For example, you do not have to collect data, or write it as a paper
ready for submission to a journal. High quality work is expected. Using canned computer
programs to analyze a data set is not an appropriate project for the course.

All students should schedule a meeting with the instructor to discuss the proposals/projects
in the first six weeks of the course.

Readings

Readings for the sessions are given below. Papers are available on Canvas and links to
these (or to their sources) are provided below. We will use the following two books, which
are available online:

(1) Easley and Kleinberg (2010) *Networks, Crowds, and Markets: Reasoning About a
    Highly Connected World*.

detection.

(1) Chapter 2: Graphs, in Easley and Kleinberg.
(2) Chapter 3: Strong and Weak Ties (including advanced material) in Easley and
    Kleinberg.
(3) Porter, M.A., J.P. Onnela and P.J. Mucha (2009), Communities in Networks, Not-
    tices of the AMS, 56 (9), 1082–1097.
(4) Bond, R. M., et al. (2012), A 61-Million-Person Experiment in Social Influence

2. Feb 3 Network centrality and its applications: Hubs-and-authorities, Pager-
    rank, Personalized Pagerank.

(1) Chapter 14: Link Analysis and Web Search, in Easley and Kleinberg.
(2) Goel, Ashish, et al. (2015), The Who-To-Follow System at Twitter: Strategy,
    98–107.

1. Chapter 4: Networks in Their Surrounding Contexts in Easley and Kleinberg.

Note: There is an interesting article in the Atlantic Magazine on the effect of overdispersion on the spreading of an infection (or information). See Tufekci, Z. (2020), This Overlooked Variable Is the Key to the Pandemic, *Atlantic Magazine*.

4. Feb 17 Threshold models of collective behavior. Information cascades.

Coordinated action.


7. Mar 10  Sponsored Search, Auctions, VCG and GSP.

(1) Chapter 9: Auctions in Easley and Kleinberg.


Note: Wired Magazine explains the use of the VCG auction by Facebook; see Metz, Cade (2015), Facebook Doesn’t Make as Much Money as It Could — On Purpose. *Wired*, 9/21/2015.


(2) Watch the Nobel Prize Lecture by Prof. Roth.
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9. Apr 8 Transformer models (note: this class meets on Friday)

(1) Selected chapters from Eugene Charniak’s book Introduction to Deep Learning
(2) Reading on transformers (to be announced)

Note: The article How Intel and Burger King Built an Order Recommendation System that Preserves Customer Privacy describes the development of the double transformer model used by Burger King.

10. Apr 14 Reinforcement learning - 1.

(1) Chapters 1 to 4, Sutton and Barto (2018) Reinforcement Learning: An Introduction. We will use a summary of the slides and lectures by David Silver (DeepMind)


(1) Chapters 5 to 7, Sutton and Barto (2018) Reinforcement Learning: An Introduction. We will use a summary of the slides and lectures by David Silver (DeepMind)
(3) Wang, Yuyan, Yuanchi Ning, Isaac Liu, and Xian Xing Zhang (2018), Food Discovery with Uber Eats: Recommending for the Marketplace

12. Apr 28 Presentations. Pick up take-home final exam (due in one week).