EC 2018 Tutorial: Information, Persuasion, and Decisionmaking

Bo Waggoner[1] and Haifeng Xu[2]

[1]UPenn. bwag@seas.upenn.edu
[2]USC. haifengx@usc.edu

Abstract / overview. The tutorial has three parts, each approximately one hour (totaling a half-day or slightly shorter). Part One covers the model of Bayesian information in games and fundamental tools, including Blackwell's ordering, Aumann's partition model, decision problems and Howard's "Value of Information", etc. Part Two overviews recent work on defining signals to be substitutes and complements in the context of a decision problem. Part Three overviews recent work on (algorithmic) persuasion games, a.k.a. signaling. Each part will briefly cover the key concepts, examples, applications, and open questions.

This will be the first incarnation of this tutorial. We will not assume prior knowledge beyond basic mathematics and probability.

Motivation. A very important up-and-coming topic — at EC, throughout CS and Economics, and in the tech industry — is the value of information and its use in games and mechanisms. While mechanisms involving the exchange of money for goods are well-studied, including at EC, we know far less about mechanisms involving *information* exchange or signaling. What is the **value** of information? How does this relate to the **decisions** made based on that information? And how do we design **algorithms** and **mechanisms** for communicating or selling information?

For example, an important and well-studied topic is the class of ad auctions with which companies such as Google and Facebook earn much of their revenue. But if one steps back, it becomes clear that the value created by these companies is centered around *information flow*. The value is, first, in the information collected about users (which allow companies to make better **decisions** about or on behalf of users); and second, in the *attention* users give to these services, which allows the services to influence user decisionmaking via interface design and advertising. There is an opportunity for economic and algorithmic research to quantify the value and usefulness of this information; and to better utilize or signal it.

The time is ripe for deeper and broader investigations into questions such as: how does one *price* information in various settings? How does one *(partially) reveal* information to achieve a particular goal? How do mechanism design and information revelation interact? The goal of this tutorial is to overview basics needed for addressing these questions as well as two recent lines of work.

Relevance. Many in the EC community, though with a sophisticated understanding of auctions for items such as Myerson's theory and beyond, have less familiarity with fundamentals of signaling, information value theory, and/or persuasion. The goal of this tutorial is to first cover some of these basics, then discuss some active areas of recent work involving settings of goal-directed information revelation. Our hope is to arm attendees with basic tools to explore many aspects of this question, then bring them up to speed on two recent lines of work (informational substitutes and algorithmic persuasion) with more concrete open problems and directions. These two lines of work (Part Two and Part Three) both utilize the fundamental tools and concepts from Part One, but in distinct settings, making for (we believe) both focus and breadth.

Summary of part one. In part one, we will very briefly cover Bayesian games and the "partition model" of signals (e.g. [1]). Then, we will define decision problems and relation to value of information (e.g. [11]). We will cover Blackwell information ordering [3]. We will also illustrate via examples how information could profoundly affect players' decisions in strategic settings.

Summary of part two. In part two, we will overview recent work on *informational substitutes and complements*. This includes definitions of when signals are substitutes or complements relative to a particular decision problem, and how this analogizes to valuation functions over substitutable and complementary goods (as well as the differences posed by information). It then includes applications in prediction markets and algorithms, and open questions in auctions and competitive markets for buying and selling information. Relevant works include e.g. [5, 4, 10, 13, 12].

Summary of part three. In part three, we will overview recent work on *(algorithmic) persuasion*. This includes the definition of persuasion games, in which one party partially reveals information in an effort to influence the decisionmaking of another. It then includes fundamental results about structure of optimal solutions, and algorithmic results on computing signaling schemes. We will also talk about its applications in various domains, including ad auctions and security games. Again, we will conclude with open problems and directions. Relevant works include e.g. [7, 8, 9, 6, 14, 15, 2].

Bios. Bo Waggoner is a postdoctoral fellow at the University of Pennsylvania's Warren Center for Network and Data Science. His research focuses on the value and elicitation of information in mechanism-design settings. At EC, he has previously co-organized a Tutorial on Information Elicitation[1] and a Workshop on Forecasting[2].

Haifeng Xu is a PhD candidate at the University of Southern California. His research focuses on understanding the role of information in strategic settings, both its theoretic foundation and real-world applications. Haifeng is a recipient of the 2017 Google PhD fellowship. His work has received the 2016 AAMAS best student paper award and the 2016 SecMas Workshop best paper award.

[1] 2016. `https://sites.google.com/site/informationelicitation/`
[2] 2017. `https://www.bowaggoner.com/ec-forecasting/`

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