On The Aggregation of Subjective Inputs From Multiple Sources

MITHUN CHAKRABORTY, Washington University in St. Louis

My research interests span algorithmic economics and machine learning, an overarching theme being the aggregation of multiple subjective inputs (e.g., forecasts on uncertain events, noisy observations of hidden truths, etc.) into a single group judgment or estimate for forecasting, decision-making etc. With the proliferation of online platforms for electronic commerce, crowdsourcing, and the harnessing of collective intelligence [Surowiecki 2005], it has become imperative to take an interdisciplinary approach towards addressing interesting nuances of the aggregation problem such as eliciting inputs from strategic agents. In my research, I use tools and concepts from across computer science, operations research, economics, and finance.

**Incentives in information aggregation.** A major focus of my work has been the analytical treatment of price properties in a prediction market, a widely used trading-based tool for belief aggregation and dissemination [Wolfers and Zitzewitz 2004]. In Chakraborty and Das [2015], we proved that when a prediction market implemented with a market scoring rule [Hanson 2003; Chen and Pennock 2007] interacts with myopic risk-averse traders, the price process behaves like an opinion pool, a classical family of belief combination rules [Genest and Zidek 1986] – this is a significant step towards explicating the precise manner in which a prediction market computes a collective forecast by incorporating inputs from all participating agents dynamically rather than in equilibrium [Ostrovsky 2012; Iyer et al. 2014]. In Chakraborty and Das [2016], we proposed a new model for studying manipulation in prediction markets when participants can influence the predicted outcome [Ottaviani and Sørensen 2007; Shi et al. 2009; Chakraborty et al. 2013; Peterson and Krug 2015] but some of them have a non-zero probability of being non-strategic, and showed that the equilibrium of this game is one of two types, depending on this probability – either collusive and uninformative or partially revealing.

**Aggregation with non-strategic agents.** I have also worked on approaches for learning from differentially informed agents, abstracting away from truth-telling incentives. This includes Chakraborty et al. [2011] where we devised an approximately Bayesian algorithm (based on Das and Magdon-Ismail [2008]) for learning a real-valued target from a sequence of censored noisy signals, and showed that it performs asymptotically almost as well as if we had uncensored signals. I am currently involved in developing and analyzing communication protocols aimed at no-regret learning for an ad hoc team [Stone et al. 2010] exploring and exploiting a multi-armed bandit.

**Market making algorithms.** Another component of my research, which is tied to both of the above strands but deals more directly with practical aspects of aggregation mechanisms, is the design and evaluation of market making algorithms [Das 2008; Othman et al. 2013]. In Chakraborty et al. [2015], we proposed a practical adaptation of the logarithmic market scoring rule, which takes market orders only, to a setting with limit order books, and uncovered interesting properties of the resulting market ecosystem. Although my work is mainly theoretical, I was also part of a team that designed and ran human-subject experiments to assess the behavior of two different market making approaches, in Brahma et al. [2012] and Chakraborty et al. [2013].

**Conclusion.** In summary, my goal is to enrich and deepen our understanding of subjective input aggregation methods used in various fields of study, and identify and address challenges encountered in practical applications of these techniques.
REFERENCES


