CS908 Assignment 4 - Research Proposal

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1 Introduction

Prediction markets are exchange-traded markets[1] that trade on the outcome of events, as opposed to traditional financial instruments. Since actors in the market participate by putting up their own money in the form of betting on an unknown future outcome, the market prices can indicate the beliefs held by the market of certain events occurring. What can make these markets even more interesting is the ability to combine these bids on events in complex ways, giving users the freedom to make predictions over a range of different unknown outcomes. This is the approach taken by *Predictalot* [1], which boasts a platform on which one can bet on over 9.2 quintillion outcomes in the NCAA Men's College Basketball playoffs. This specification outlines the plans to implement a similar combinatorial prediction market for betting on outcomes in the Gallagher Premiership Rugby league, placing as few restrictions as possible on the types of bets available to traders.

The rest of the specification is structured as follows. In Section 2 we outline in greater detail the motivation for such a project, highlighting the gaps in the current literature and presenting our specific goals for the platform. In Section 3 we discuss recent results in mechanism design for combinatorial auctions as well as current software implementing other prediction markets. In Section 4 we outline the methods and approaches we plan to take in order to complete this project. Aspects related to the effective management of the project are discussed in Section 5. We conclude with a brief discussion of progress made thus far in Section 6, followed by closing thoughts and plans for the next stages in Section 7.

2 Background

2.1 Problem Statement

Prediction markets provide ways in which to bet on the occurrence of events in the future, and are often used to bet on a variety of circumstances – this could be on the outcomes of a political election, sporting events, or any other probabilistic event. Since there is an incentive to do well in such a market, by players staking their own money or units from some point system, people are inclined to bet how they truly feel about certain events, and hence public sentiment on these events can be crowdsourced to learn how likely they are thought to occur. Combinatorial prediction markets, taking inspiration from the theoretical economics and mechanism design literature, allows for multiple bets to be bought and sold at once, and it is how these are combined in complex ways that we may learn the most about how the public view the likelihood of separate events as being related.

It is well-known, however, that computing allocations of goods to buyers that maximises, for example, social welfare or revenue, requires solving an NP-hard optimisation problem [3]. Furthermore, for a market offering bets on n separate events, there are 2^n possible ways of combining such bets – how can we expect users to enter an exponential number of bids before they even get to participate in the market? These two problems are the focus of much of the literature within algorithmic mechanism design [2], a subfield within algorithmic game theory. Broadly, this is an area of research at the intersection of economics and computer science that is concerned with designing the ways in which self-interested agents act within a strategic environment to achieve certain economic properties – truthfulness, budget balance, individual rationality, for example – while ensuring that the mechanisms remain practical to implement. It hence makes extensive use of techniques favoured in computer science, most notably asymptotic analysis, randomisation, and approximation. The goal in the modern literature therefore departs from striving to compute the idealistic but impractical optimal solution, towards computing ones which are approximately-optimal, or "good enough".

[1] A market in which all transactions are routed through a central source.

Even restricting ourselves to approximately-optimal solutions, we are faced with another problem – how do we define "good enough"? What makes, say, a 6-approximation for computing an allocation in a two-sided market any better than a 7-approximation that also achieves group-strategy proofness?[2] The answer is that it depends – trade offs must be made on a variety of parameters and assumptions that we make on the model. For example, are buyers required to submit a bid on a single bet, stopping the ability for bets to be combined but yielding a better approximation, or can they submit up to k desired sets of bets, at the cost of some performance?

2.2 Aims

3 Related Work

3.1 Contemporary Literature

3.2 Existing systems

4 Research Processes

5 Project Management

6 Progress

7 Conclusion

References

[1] *Predictalot! (and we mean a lot).* `http://blog.oddhead.com/2010/03/05/predictalot/`. Accessed: 2020-02-16.

[2] N. Nisan and A. Ronen, *Algorithmic mechanism design (extended abstract)*, in Proceedings of the Thirty-First Annual ACM Symposium on Theory of Computing, STOC '99, New York, NY, USA, 1999, Association for Computing Machinery, p. 129–140.

[3] ——, *Computationally Feasible VCG Mechanisms*, J. Artif. Int. Res., 29 (2007), p. 19–47.

[2] These are just examples to illustrate the point and may or may not exist.