Interdependent Values without Single-Crossing [Abstract]

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We consider a setting where an auctioneer sells a single item to n potential agents with *interdependent values*. That is, each agent has her own private signal, and the valuation of each agent is a known function of all n private signals. This captures settings such as valuations for oil drilling rights, broadcast rights, pieces of art, and many more.

In the interdependent value setting, all previous work has assumed a so-called *single-crossing condition*. Single-crossing means that the impact of a private signal, s_i, on the valuation of agent i, is greater than the impact of s_i on the valuation of any other agent. It is known that without the single-crossing condition, an efficient outcome cannot be obtained. We ask what approximation to the optimal social welfare can be obtained when valuations do not exhibit single-crossing.

We show that, in general, without the single-crossing condition, one cannot hope to approximate the optimal social welfare any better than assigning the item to a random bidder. Consequently, we consider a relaxed version of single-crossing, *c-single-crossing*, with some parameter $c \geq 1$, which means that the impact of s_i on the valuation of agent i is at least $1/c$ times the impact of s_i on the valuation of any other agent ($c = 1$ is single-crossing). Using this relaxed notion, we obtain a host of positive results. These include a prior-free universally truthful $2\sqrt{n}c^{3/2}$-approximation to welfare, and a prior-free deterministic $(n-1)c$-approximation to welfare. Under appropriate concavity conditions, we improve this to a prior-free universally truthful $2c$ approximation to welfare as well as a universally truthful $O(c^2)$-approximation to the optimal revenue.

CCS Concepts: •**Theory of computation → Algorithmic game theory and mechanism design;**

Additional Key Words and Phrases: Interdependent values; single-crossing; welfare maximization; prior-free

A full version of this paper is available at https://www.cs.tau.ac.il/~alonarde/interdependent.pdf.

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The work of A. Eden, M. Feldman, and K. Goldner was partially supported by the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013) / ERC grant agreement number 337122, and by the Israel Science Foundation (grant number 317/17). The work of A. Eden and A. Fiat was partially supported by ISF 1841/14. The work of K. Goldner was supported in part by NSF award CCF-1420381 and by a Microsoft Research PhD Fellowship.

ACM EC'18, June 18–22, 2018, Ithaca, NY, USA.

ACM ISBN 978-1-4503-4529-3/18/06.
https://doi.org/10.1145/3219166.3219173