Heuristic Auctions

Paul Milgrom*
Ilya Segal**

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ABSTRACT

The paper examines a novel class of procurement auctions for single-minded bidders, in which the auctioneer must select a subset of bids to be accepted subject to complicated constraints, possibly including a constraint on the total payment. (This problem is inspired by the Federal Communication Commission's problem of buying out broadcast TV licenses to repurpose electromagnetic spectrum subject to the constraint that the remaining TV stations can be retuned into the remaining TV spectrum without excessive interference on each other). The complexity of the constraints may preclude the computation of a set of bidders to maximize some objective. Instead, we propose a class of computationally feasible "heuristic" auctions that calculate both a feasible set of bids to be accepted and "threshold" payments to those bidders to induce strategyproof bidding. The calculation iteratively rejects the highest-scoring bid that could still be feasibly rejected, with the bidders' scores computed from their bids and other criteria (including the bids previously rejected). We show that such heuristic auctions can be characterized as being equivalent to clock auctions in which bidder-specific prices descend over time and bidders can quit any time their prices are decremented. Furthermore, we establish "payoff equivalence" results between "threshold" or "clock" auctions on one side and their paid-as-bid counterparts on the other, under the assumption of full information: First, we show that a paid-as-bid heuristic auction has a full-information Nash equilibrium with the same allocation and prices as the "threshold" auction with the same allocation rule. Second, under additional restrictions on the heuristic allocation rule, there is a unique allocation and unique prices for the paid-as-bid auction that survives iterated deletion of weakly dominated strategies, and that emerge at any Nash equilibrium in weakly undominated strategies.

* Stanford University; http://www.milgrom.net/

** Stanford University; http://www.stanford.edu/~isegal/