

The Importance of Ordering in Sequential Auctions

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Abstract

To date, the largest part of literature on multi-unit auctions has assumed that there are k homogeneous objects being auctioned, where each bidder wishes to win exactly one or all of the k units. These modeling assumptions have made the examination of ordering in sequential auctions inconsequential. The aim of this paper is to introduce and highlight the critical influence that ordering can have on the efficiency of an auction. We study a buyer who outsources via sequential 2nd price auctions, 2 heterogeneous jobs and faces a diverse set of suppliers with capacity constraints.

1 Motivation

We have witnessed an explosion of commercial activity over the Internet in the last few years. Companies are using the Internet's connectivity and convenience to transform themselves, cut costs, and increase their profitability. The Internet especially holds enormous promise to bring cost savings to the "stepchild" in most companies: the purchasing department. It is estimated that manufacturers spend over \$5 trillion a year, or 35 cents for each dollar in sales, purchasing industrial parts [23]. Companies in diverse industries, including paper, automotive, and electronics, are turning towards Internet auctions as a competitive means by which to procure industrial components and services. By moving increasing portions of their business into auctions, companies are opening the door for new suppliers to compete for their business. Many companies

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have placed their beliefs (and a substantial amount of money) in the ability of an auction to aid them in procuring goods and services at reduced prices.

Most industrial procurement auctions involve a large buyer (such as General Electric, United Technologies) who wish to outsource from a set of (smaller) suppliers. Typically, the buyer wishes to procure multiple items where no single supplier is large enough, i.e., has sufficient capacity, to fill the buyer's entire order. That is, the buyer is trying to procure *multiple*, possibly *heterogeneous* production orders from a pool of suppliers who have binding *capacity constraints*. The critical decisions the auction designer must make include (i) how to partition the buyer's order into smaller bundles (jobs) that the suppliers can bid on, (ii) how to sequence the auctioning of the smaller jobs, i.e., conduct the auctions simultaneously or sequentially, and (iii) if done sequentially, in which *order* should the jobs be auctioned?

In this paper, we focus on the third dimension, that is, the impact of ordering on the performance of sequential auctions. In particular, we seek to identify when a sequential 2^{nd} price auction awards heterogeneous production orders to the most efficient suppliers who have capacity constraints and possible *economies of scale* in production. We introduce and highlight the critical relationship between the *ordering* and the *efficiency* of an auction. We find that the efficient ordering in a sequential auction is critically linked to the suppliers' cost structure, and identify a general class of cost functions for which efficient equilibria exist.

A procurement auction is said to be efficient if it awards the buyer's business to the set of suppliers with the lowest (total) production costs. The search for efficient multi-unit auctions is a difficult one and has been the focus of many recent papers ([1] [2] [6]). The design of an efficient auction has theoretical appeal (and practical appeal in certain environments); however, buyers are typically more concerned with the impact of an auction design on their procurement costs. While a definitive link between efficiency and revenue has yet to be established in multi-unit auction settings, it is generally accepted that the seller faces an inherent tradeoff between payments and efficiency ([12] [17]). We demonstrate that this does not appear to be the case when selecting the ordering of auctions: We find that an efficient ordering does in