Comparative Evaluation of Independent Private Values Distributions on Internet Auction Performance

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ABSTRACT
The Independent Private Values (IPV) model is foundational for the analysis of Internet auction performance and is widely used in the study of auction behaviour. The characteristics of this model include the assumptions of privacy and independence where the value of the commodity in question is private to the individual buyers, and that different buyers do not know the values other buyers attached to the commodity. In addition, these values are drawn from a common distribution which is known to the buyers. In probabilistic terms, this essentially amounts to a series of values which are independent and identically distributed. The features and characteristics of the IPV distribution will have a significant impact on auction behaviour, and since a general stochastic analysis of their impact is analytically intractable, here auction performance is studied using an auction process simulator. Both hard close and soft close Internet auctions are studied. In addition, Vickrey auctions and auction mechanisms with multiple bid acceptance are compared and evaluated. From experimental findings, the paper establishes quantitative relationships between the different auction process parameters, deploy suitable IPV distributions to model the characteristics of different communities of bidders, provide suggestions for optimising auction performance, and recommend strategies for efficient auction design.

Keywords: Auction Duration, Auction Income, First Price, Internet Auctions, Multiple Bids, Online Auctions, Vickrey

INTRODUCTION
Instead of companies selling items to consumers, consumers are now selling items among themselves, with a common mechanism of achieving this being the auction. In fact, auctioning allows for a departure from the fixed price model, which some regard as too rigid to be able to respond rapidly to supply and demand fluctuations and changes. The pervasiveness and ubiquity of the Internet has played a pivotal role in catalysing the widespread acceptance of such a variable pricing model.

Internet auctions exhibit characteristics which are not often shared with conventional auctions, e.g., auctions of fixed duration which
encourage sniping (bidders submit their bids moments before the close of an auction thereby preventing other bidders from submitting counter-bids), the acceptance of multiple bids in a single auction, and a maximum threshold whereby the auction will terminate at that price point. Due to lack of regulation, the size of the market and the volume of bidders and sellers, Internet auctions are better suited to incorporating algorithms of increased complexity as opposed to the more established procedures at traditional auction houses. For example, while eBay runs what essentially amounts to an English auction with a fixed duration, Swoopo runs what is known as a penny auction, where each bid incurs a fee and also extends the length of the auction by a short amount (10-20 seconds).

One way to view an auction is to regard it as the determination of bidders’ valuations by the seller with the hindrance of concealed information from bidders (Cowell, 2006). The value of the object being sold (or lot) can either be the same for everyone and bids will vary according to the accuracy of the information a bidder holds, or each bidder will have his own private valuation that is unaffected by the valuations of those around him, whether known to him or not. The Independent Private Values model (Parsons et al., 2011) include the assumptions of privacy and independence where the value of the commodity in question is private to the individual buyers, and that different buyers do not know the values other buyers attached to the commodity. In addition, these values are drawn from a common distribution, which is known to the buyers. In probabilistic terms, this essentially amounts to a series of values, which are independent and identically distributed. A common distribution used is the uniform distribution. In this paper, through the use of simulations, we show that the results of auctions, measured through metrics such as average auction income and average auction duration, remain largely insensitive to the underlying private value distribution because the auction incomes tend towards a similar value for high bid rates.

There has been substantial work done on auctions, with several books written on the topic (Cramton, 2006; Klemperer, 2004; Krishna, 2002; Milgrom, 2004). A stochastic number of bidders are studied in McAfee and McMillian (1987) where first-price sealed-bid auctions having constant absolute risk aversion is analysed. As a result of the stochastic analysis, the authors conclude that the seller should conceal the number of bids in order to maximise the selling price. Stochastic models of bid arrival characteristics are studied in Shmueli et al. (2007) and Russo et al. (2008) where the so-called BARISTA (Bid ARrivals InSTAges) model that makes use of non-homogeneous Poisson process is proposed. The probabilistic and statistical properties of these models are analysed and studied and the usefulness of these models for auction modelling is illustrated and discussed.

A stochastic approach to Internet auctions is given in Gelenbe (2009), where bid arrivals also follow a Poisson process, with successive bids increasing in value and the seller’s problem is to decide when it should accept a bid. After each bid, the seller waits for some random decision time to determine whether to accept the offer. If a new bid arrives before that time expires, then the process is repeated for this new bid. However, if a new bid does not arrive before this time expires, then the seller accepts the current bid. If the seller accepts the offer too quickly, then the price obtained may be low with respect to the price that the seller would have received had he or she been more patient. On the other hand, if the seller waits a long time before accepting an offer, a higher price may be obtained but at the expense of wasting more time. After selling the good, the seller rests for some random time before initiating a new auction. Characteristics of this mechanism include decision time, rest time, and maximum bid value. These may be adjusted, which will affect the auction duration. Similarly, in this paper, we simulate the bid arrivals as a Poisson process, and we follow the commonly adopted Independent Private Values approach in which
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