MODELING THE DYNAMICS OF ONLINE AUCTIONS

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Research by **Galit Shmueli** and **Wolfgang Jank**

THE EXPLOSIVE GROWTH OF ONLINE AUCTIONS HAS INSPIRED A PLETHORA OF RESEARCH—MOST OF IT IN THE AREA OF ECONOMICS AND INFORMATION SYSTEMS. STATISTICIANS, THOUGH, WERE OFTEN SIDELINED BECAUSE THEY LACKED THE TOOLS NECESSARY TO MINE THIS RICH WORLD OF DATA. BUT WITH THE HELP OF SOME EXPERT COLLEAGUES, SMITH SCHOOL STATISTICIANS ARE WEIGHING IN WITH A NEW TAKE ON AUCTION DATA ANALYSIS.

Galit Shmueli, assistant professor of decision and information technologies, and Wolfgang Jank, assistant professor of decision and information technologies, investigate the bidding dynamics of auctions in their paper “Modeling the Dynamics of Online Auctions: A Modern Statistical Approach.” Shmueli and Jank describe the process as similar to that of studying a NASCAR race. Rather than focusing solely on the winner’s score, they look at route, speed, acceleration and other dynamic characteristics.

In an auction context, the dependent variable is not a static point like the end price, but the bidding curve throughout the auction. This provides answers to questions like: How fast do bids arrive at different stages of the auction? How fast does the bidding curve move toward the final price? Which dynamics are common and which are different across various auctions?

Understanding auction dynamics is important for understanding and evaluating the information gained by other methods of analysis. For example, Jank and Shmueli’s research reveals that auctions are not homogenous, even when the exact same product is being offered over an identical time frame. “Even if the end price is the same, they may have gotten to that end price very differently,” says Shmueli.

Despite the wealth of data available (in the case of eBay, for free), auction dynamics received scant attention from statisticians. Data collection has been the primary problem. E-commerce data is obtained using software agents called spiders, the code for which is written by the research team for a specific purpose. These spiders can capture the hundreds of bids and time stamps within a single auction and can do so for several thousand auctions at a time. But statisticians are often unaware of the software programs needed to collect data from electronic commerce.

Close collaboration with their information systems colleagues in the Smith School's Center for Electronic Markets and Enterprises gave Shmueli and Jank access to data-collecting experts. "No one knew how to get these data," says Shmueli. "Statisticians are data-poor, so we benefit from the data-collection expertise of our information systems colleagues."

The problem of modeling auction dynamics is not limited to the difficulties in extracting the raw data. Traditional methodology such as regression and timeseries models are inadequate because of the nature of the information involved. For example, a single bidding sequence in a particular auction forms a time series,but it is difficult to compare hundreds or thousands of bidding sequences across multiple auctions because the bidding sequences are not of the same length. Statistical methods used in the field of online auctions also tend to aggregate the available data over the auction duration, over auctions, or both. Though convenient for summarizing data, aggregation loses the richness of the information available.

Jank suggested using Functional Data Analysis, a state-of-the-art statistical method that turns out to be well suited to auction data. "It's impossible to extract all the useful information using traditional statistical methods," says Jank.

Functional Data Analysis uses functions—curves—as the basis for statistical analysis. Each bid sequence is represented by a curve; the curves are then plotted and their overall features characterized. Cluster analysis is used for learning about the natural groupings of auctions and functional regression can be used to study the effect of bidder, seller and auction characteristics on the auction dynamics. In order to illustrate each method, Shmueli and Jank used a collection of data on 353 closed auctions that took place on eBay.com during November-December 2003. Shmueli and Jank imagine consumer applications being developed from their work that would allow buyers to make more informed bidding decisions.

"Understanding the dynamics of an auction would let you decide if it was worthwhile to stay in a certain auction," says Jank. "A software program could track the bidding curves of hundreds of auctions and make recommendations based on the curves. You could see which auctions were going to end with a price that was too high, and go to a different one."

Shmueli's and Jank's research into online auctions continues in collaboration with colleagues from the Smith School, University of Connecticut, University of Iowa, and Florida State University. "Modeling the Dynamics of Online Auctions" will appear as a chapter in "New Empirical Methods in E-Commerce," edited by Robert Kauffman (forthcoming). For more information on this study and other work sponsored by the Smith School's Center for Electronic Markets and Enterprises, visit http://www.smith.umd.edu/ceme/.