Auctions

Auctions used to be comparatively rare in everyday life; every now and then, one would hear of astronomical sums paid at auction for a painting by Monet or Van Gogh, but other than this, they did not enter the lives of the majority. The Internet and Web fundamentally changed this. The Web made it possible for auctions with a large, international audience to be carried out at very low cost. This in turn made it possible for goods to be put up for auction which hitherto would have been too uneconomical. Large businesses have sprung up around the idea of online auctions, with *eBay* being perhaps the best-known example.

One of the reasons why online auctions have become so popular is that auctions are extremely simple interaction scenarios. This means that it is easy to automate auctions; this makes them a good first choice for consideration as a way for agents to reach agreements. Despite their simplicity, auctions present both a rich collection of problems for researchers, and a powerful tool that automated agents can use for allocating goods, tasks, and resources.

Abstractly, an auction takes place between an agent known as the auctioneer and a collection of agents known as the bidders. The goal of the auction is for the auctioneer to allocate the good to one of the bidders. In most settings – and certainly most traditional auction settings – the auctioneer desires to maximize the price at which the good is allocated, while bidders desire to minimize price. The auctioneer will attempt to achieve his desire through the design of an appropriate auction mechanism – the rules of encounter while bidders attempt to achieve their desires by using a strategy that will conform to the rules of encounter, but that will also deliver an optimal result.

Auctions differ in the methods used for the submission of bids and for the determination of the final price paid by the winner. In addition, auctions can be classified according to the way in which buyers might value the object being auctioned. Here we categorize the various auction types, describing their characteristics and mechanics.

The four major categories of auctions can be divided into two groups. The first group is known as open outcry. In this type of auction,

bidders call out or otherwise make their bids in public. All bidders are able to observe bids as they are made. This type perhaps best fits the popular vision of the way in which auctions work – an image that includes feverish bidders and an auctioneer. But open outcry auctions can be organized in two ways. Only one of them would ever demonstrate "feverish" bidding.

The *ascending*, or *English*, version of an open-outcry auction conforms best to this popular impression of auctions. Ascending auctions were and still are the norm at English auction houses such as Christie's and Sotheby's from which they take their alternate name. The auction houses have a conventional auctioneer who starts at a low price and calls out successively higher prices for an item, waiting to receive a bid at each price before going on. When no further bids can be obtained, the item goes to the most recent, highest, bidder. Thus, any number of bidders can take part in English auctions, although only the top bidder gains the item up for sale. And the bidding process may not literally entail the actual outcry of bids, because the mere nod of a head or the flick of a wrist is common bidding behavior in such auctions. A large majority of the existing Internet auction sites now run what are essentially ascending auctions (in virtual, rather than real, time) for almost any item imaginable.

The other type of open outcry auction is the *Dutch*, or *descending*, auction. Dutch auctions, which get their name from the way in which tulips and other flowers are auctioned in the Netherlands, work in the opposite direction from that of English auctions. The auctioneer starts at an extremely high price and calls out successively lower prices until one of the assembled potential bidders accepts the price, makes a bid, and takes the item. Because of the desire or need for speed, Dutch flower auctions, as well as auctions for other agricultural or perishable goods (such as the daily auction at the Sydney Fish Market), use a "clock" that ticks down (counterclockwise) to ever lower prices until one bidder "stops the clock" and collects her merchandise. In many cases, the auction clock displays considerable information about the lot of goods currently for sale in addition to the falling price of those goods. And, unlike the English auction, there is no feverish bidding in a Dutch auction, because only the one person who "stops the clock" takes any action.

The second group of auctions are those that are conducted by *sealed bid*. In these auctions, bidding is done privately and bidders cannot observe any of the bids made by others; in many cases, only the winning bid is announced. Bidders in such auctions, as in Dutch auctions, have only one opportunity to bid. (Technically, you could submit multiple bids, but only the highest one would be relevant to the auction outcome.) Sealed-bid auctions have no need for an auctioneer. They require only an overseer who opens the bids and determines the winner.

Within sealed-bid auctions, there are two methods for determining the price paid by the high bidder. In a *first-price sealed-bid* auction, the highest bidder wins the item and pays a price equal to her bid. In a *second-price sealed-bid* auction, the highest bidder wins the item but pays a price equal to the bid of the second-highest bidder. A second-price structure can be extremely useful for eliciting truthful bids, and such auctions are often termed *Vickrey auctions* after the economist who first noted this particular characteristic.

The sealed-bid auctions are each similar, in regard to bidding strategy and expected payoffs, to one of the open-outcry auctions; first-price sealed-bid auctions are similar to Dutch auctions, and second-price sealed-bid auctions are similar to English auctions.

The bidding strategy in a Vickrey auction

Suppose you are an antique china collector and you have discovered that a local estate auction will be selling off a 19th century Meissen "Blue Onion" tea set in a sealed-bid second-price auction. As someone experienced with vintage china but lacking this set for your collection, you value it at $3000, but you do not know the valuations of the other bidders. If they are inexperienced, they may not realize the considerable value of the set. If they have sentimental attachments to Meissen or the "Blue Onion" pattern, they may value it more highly than the value that you have calculated.

The rules of the auction allow you to bid any real-dollar value for the tea set. We will call your bid b and consider all of its possible values.

The success of your bid will obviously depend on the bids submitted by others interested in the tea set, primarily because you need to consider whether your bid will win. The outcome thus depends on all rival bids, but only the largest bid among them will affect your outcome. We call this largest bid r and disregard all bids below r.

What is your optimal value of b? We will look at bids both above and below \$3000 to determine whether any option other than exactly \$3000 can yield you a better outcome than bidding your true valuation.

We start with $b > 3000$. There are three cases to consider. First, if your rival bids less than \$3000 ($r < 3000$), then you get the tea set at the price r. Your profit, which depends only on what you pay relative to your true valuation, is $(3000 - r)$, which is what it would have been had you simply bid \$3000. Second, if your rival's bid falls between your actual bid and your true valuation ($3000 < r < b$), then you are forced to take the tea set for more than it is worth to you. Here you would have done better to bid \$3000; you would not have gotten the tea set, but you would not have given up the $(r - 3{,}000)$ in lost profit either. Third, your rival bids even more than you do ($b < r$). You still do not get the tea set, but you would not have gotten it even had you bid your true valuation. Putting together the reasoning of the three cases, we see that bidding your true valuation is never worse, and sometimes better, than bidding something higher.

What about the possibility of shading your bid slightly and bidding $b < 3000$? Again, there are three situations. First, if your rival's bid is lower than yours ($r < b$), then you are the high bidder, and you get the tea set for r. Here you could have gotten the same result by bidding \$3000. Second, if your rival's bid falls between 3000 and your actual bid ($b < r < 3000$), your rival gets the tea set. If you had bid \$3000 in this case, you would have gotten the tea set, paid r, and still made a profit of $(3000 - r)$. Third, your rival's bid could have been higher than \$3000 ($3000 < r$). Again, you do not get the tea set but, if you had bid \$3000, you still would not have gotten it, so there would have been no harm in doing so. Again, we see that bidding your true valuation, then, is no worse, and sometimes better, than bidding something lower.

If truthful bidding is never worse and sometimes better than bidding either above or below your true valuation, then you do best to bid truthfully.

That is, no matter what your rival bids, it is always in your best interest to be truthful. Put another way, bidding your true valuation is your dominant strategy whether you are allowed discrete or continuous bids.

References

M. Wooldridge, *An Introduction to MultiAgent Systems*, John Wiley & Sons, 2002.

A. Dixit, S. Skeath, *Games of Strategy* (2nd edition), W. W. Norton & Company, 2004.