

# Maximizing Sellers' Profit in Online Auctions

Feifan Li<sup>1, a</sup>, Jingyi Liang<sup>2, b</sup>, Lyu Ke<sup>3, c</sup>

<sup>1</sup>Guanghua International High School, Shanghai, 20000, China

<sup>2</sup>Bath College, Bath, BA1 1UP, the UK.

<sup>3</sup>CATS College, Canterbury, CT1 3LQ, the UK.

<sup>a</sup>3313304985@qq.com, <sup>b</sup>LIA21002252@student.citybathcoll.ac.uk, <sup>c</sup>2469631484@qq.com

These authors contributed equally

**Keywords:** Sellers' profit, online auctions, marketing strategies.

**Abstract:** An online auction is a common transaction that allows multiple buyers to bid on one or more items offered by the seller. Assuming that sellers aim to maximize profits, how do they sell the item at the most profitable price in the auction process? Because of the obvious differences between auctions, sellers should take specific approaches depends on the situation. This paper introduces some basic theories and characteristics of auction, focusing on the discussion and analysis of the English auction and the Dutch auction. Sorted out relevant materials and data, and made a comparison of strategies to maximize sellers' profit from the two most typical auctions: the English auction and the Dutch auction. By organizing relevant literature in recent years, comparing and modifying known theoretical knowledge to obtain more appropriate auction strategies for different types, which will help sellers in online auction better maintain their profits and development in the market.

## 1. Introduction

### 1.1 Research background

An auction is a type of spot transaction in which an auction house specializing in auction business accepts the owner's entrustment, shows the items to be auctioned to the buyer at the designated time and place, conducts public bidding and bidding, and then sells the goods to the highest bidder. Online auctions have grown quickly in recent years, notably during the pandemic, as a result of the expansion of the auction business, removing the physical limits of traditional auctions such as region, presence, and time. In this instance, internet auctions provide both vendors and buyers with a secure and efficient venue.

Moreover, different auction sites use various auction processes. We'll go over the two most popular auctions briefly, which are the English auction and the Dutch auction. While most people focus on how to optimize the interests of customers, this study focuses on the seller, improving traditional theory and incorporating science and technology into the auction process. Because buyers and sellers are the two primary participants in the auction market, and sellers are ready to pick the auction mode over regular sales, it demonstrates that auctions must have a unique manner of profiting, which is also the topic we want to investigate.

### 1.2 Research significance

The first reason to investigate how auction vendors generate money is that it is a relatively new issue. The majority of students are concerned about how to get their preferred items at a lower price at an auction. Our team thinks that the traditional auction sales procedure and the invention of new ways to help sellers are inextricably linked. Second, because the seller can better assist us in utilizing the notion of game theory in the auction, it is also an intriguing issue to consider how the seller plays games with a large number of customers in order to promote commodity consumption.

### **1.3 Paper organization**

The English auction and the Dutch auction are two of the most popular auction systems on the Internet. The fundamental methods for the two auctions will be presented first, followed by an examination of how the seller makes money in these two auctions.

The essay begins by outlining the history and origins of auctions, as well as reiterating the study goal of this work. The purpose of this paragraph is to provide a basic grasp of auction to the general public in order to help our subsequent presentation. Part 2.1 discusses the advantages of online auctions. The number of individuals who opt to utilize auction software has expanded dramatically as a result of population expansion or epidemics, providing a solid basis for the auction market. Then this paper introduces the two types of auctions in part 2.2, which are the classic English auction and the Dutch auction, as well as how sellers utilize the game theory and other techniques to raise their profit. At the end, part 2.3 goes further and expands a more academic analysis. We examined and computed after reviewing the literature and eventually came to a conclusion.

### **2. Overview of online auctions**

Online auctions may be dated all the way back to 1995. In that year, two auction sites with different business concepts were launched. Onsale, created by Jerry Kaplan and debuted in May 1995, was the first auction site [1]. Pierre Omidyar started the second auction site, eBay, in September of the same year, and it is currently the world's largest auction site. Online auctions have swiftly become one of the most popular e-commerce applications since its inception. With the passage of time, online shopping has become increasingly popular. The impact of the coronavirus outbreak has accelerated the growth of online purchasing.

Hundreds of websites now support online auctions, allowing customers to bid directly on expensive, unusual and even various assets. Different products also have a variety of suitable types of auction. It can be roughly divided into four types, English auction, Dutch auction, first-price sealed-bid and second-price sealed-bid auction. Sealed-bid auction is generally used to bid government contracts. While both English and Dutch auction can be used to sell a variety of goods, not just a packet of seeds for the agricultural market, but also a house for real estate, or for the country's bonds market.

### **3. Advantages of online auctions**

The development of technology has brought a lot of convenience to auction, making it more common. The advantages of online auctions over traditional auctions include cost savings, more visibility and participation, and a more full and unambiguous introduction of the product [2]. On this basis, the new ideas presented in this paper are lower risk of collusion and more efficient pricing.

The growing popularity of online auctions has resulted in a plethora of auction rules. The "buy it now" auction, which is created by combining a fixed price and an online English auction, is one of them. It gives buyers with a handy option by setting a fixed price in the auction, allowing them to buy the item without bidding. In the year 2000, eBay introduced the "buy it now" feature. Its rule is that the first consumer to participate has the option of bidding or purchasing it right away. The "buy it now" option vanishes once the first person chooses to bid, and the latter can only engage in bidding. This strategy is referred to as "temporary buy it now".

Firstly, online auctions are less expensive than physical auctions and take less time to introduce a product to a buyer; the seller simply needs to post a product description online, and interested buyers will find it. Lucky Reiley mentioned the application of buy it now price in the review of online auction in 2000, and it also shows that there is no theoretical literature on the effect of buy it now price in auction [3]. Budish and Takeyama proved the benefits of buy it now auction in theory for the first time [4]. They used a simple model (the model includes two bidders and two valuations) to set an appropriate "buy it now price" to face risks.

Secondly, due to the size of the venue, there is always a limit to the number of buyers that can be accommodated at live auctions. This is not the case on the internet, where the number of consumers is

limitless and people can simply search for keywords to find the things they want to buy as well as details.

Thirdly, sellers can introduce the product more comprehensively and clearly. In real auctions, it is often the auction platform that introduces the product to the buyer, which may lead to a less detailed and comprehensive presentation of the product. But online auction platforms allow sellers and buyers to communicate one-on-one, which is more convenient as well as faster compared to real-life auctions. In addition, we believe that online auctions reduce the risk of collusion and make price setting more efficient. Online auctions are fairer, and sellers can refer to the prices set by other peers, making pricing more reasonable.

#### 4. Different types of auctions

Around the world there are many types of auction, and among them 2 types of auctions are famous. The most common type of auction is the English auction, often known as “increasing price auction” or “undervalued auction”.

Bidding for the auction object in the auction process is a standard auction approach. Which means consumers bid price from low to high, the bidding ladder rises. The highest bid place is placed when the auction deadline is reached. The bidding war is won by the highest bidder (i.e. from the bidder to the buyer). The seller can set a preset reserve price before the auction. The seller has the right not to sell the auction item if the highest bidding price is less than the reserve price.

The seller, on the other hand, are able to establish an unreserved price. The highest bidding price will be attained at this time, when the auction deadline is met.

The benefits of an English auction are obvious; the operation is straightforward, which can make the value difficult to assess or unclear, maximizing the worth of products. The winning bidder simply needs to offer a little higher than the previous highest price, and each bidder is unwilling to bid at its anticipated price right away, which is one of the disadvantages of English auction. Furthermore, bidders must take a risk. The interesting bidding process may attract bidders, resulting in a bid that surpasses the expected price. The “winner’s curse” is the name given to this psychological phenomena [5].

Auction process is also easy. First, announce auction rules to consumers, then, the auctioneer makes an offer. After that, the buyer makes a bid while others bidders start bidding in turns. At last, the people who bid up the highest price win transaction.

Auction rules may differ from one to another but same in core. For instance, the starting price of this auction is 0 yuan, and the minimum increase in the bid is 1 yuan. As show in Table1, the same bidding price is based on: the first offer shall prevail, and the offer shall not be repudiated. The bidder’s highest offer shall be hammered or rejected by the auctioneer. The auction shall be concluded after confirmation by other means of public expression of purchase order.

Table 1. Procedures of bid up price during English auction

	Money
Starting price	0
1 time bid up price	1
2 time bid up price	2
3 time bid up price	3

Currently, many merchants are using Dutch auctions to raise funds. The Dutch auction is a unique type of auction. It’s also known as a “price reduction auction”, and it’s an auction method in which the auction “target bidding”’s price drops from high to low until the first bidder answers (reaches or exceeds the reserve price).

There is just one item in a typical auction that is decided in one stroke. Auctions in the Netherlands frequently begin with very high prices, and no one bids on occasion. When a specific period has passed, the price will decrease by a predetermined amount until someone is willing to accept it.

In addition, there are two ways to participate in the Dutch auction. The first option is to wait until it is completely sold out. For example, if a tulip seller want to sell all tulips today. He then intends to use Dutch auction. First, the vendor establishes a maximum price per tulip of 100 yuan. The hourly rate has been cut by ten yuan. And the merchant promised a discount if someone purchased it inside the first hour. Buy two and receive a third for free. Perhaps no one bought after the auction started, or perhaps someone bid to acquire a few. The remaining items will thereafter be lowered every other hour until they are all gone. It is important to note that it is not being auctioned at the current price. The price the consumer pays is the current price. Instead, use an average price until it's finished. This is the price consumer will pay. Sell ten at 100 yuan each, for a total of 1000 yuan. Sell 40 for 50 yuan each, for a total of 2000 yuan, and 50 for ten yuan each, for a total of 500 yuan. Then  $(1000 + 2000 + 500) / 100 = 35$  yuan is the average cost.

The second is to go all the way to the summit. Suppose the flower seller is still selling. There are 100 flowers in this bouquet. It is agreed that if the sellers have already made profits enough or even more than 2000 yuan, they will not be able to sell them. The price will be reduced by 10 yuan per hour, starting at 100 yuan per flower. It further stated that anyone who purchased within the first hour would receive a discount. If a person purchases ten roses in the first hour. The price was then decreased to 50 yuan, and someone purchased 20 of them. It has now reached the seller's stated price of 2000 yuan. The sale has ended. A total of 30 flowers were sold for 2000 yuan at the time. The price per flower is  $2000 / 30 = 67$  yuan. Of course, there will be a discount for those who purchase inside the first hour.

And now, in order to make a profit, huge corporations have embraced Dutch auctions. At the time, the Boca cross-chain agreement was also the hottest project. We've already done enough publicity at this point. Then, until the auction was sold out, the Dutch auction was used. A total of 5 million dot tokens will be sold in a public sale. Participants who complete the first hour will receive a 15% bonus. For a period of two years, the token will be locked. A total of 400000 ethers had been raised by the time the 5 million tokens were sold out. The crowdfunding process took several days. In terms of the entire crowdfunding process, the project side of crowdsourcing is quite successful.

Many people may hesitate when a project begins crowdfunding for fear that the cost would be too high and there will be no benefit, and so miss out on the entire campaign.

## 5. Maximization of sellers' interests

Depending on the different characteristics of English auctions and Dutch auctions. The way in which sellers benefit from these two types of auction is also different.

Under general assumptions on the buyer's preferences and information structure, one may develop incentive-compatible and individually rational trading procedures that dominate the English auction in terms of the seller's projected income, according to the theory of mechanism design. If all purchasers are risk-averse, any nonzero degree of correlation among their private information, no matter how little, allows the seller to capture all projected benefits from transaction.

In Milgrom and Weber's "general symmetric model", they showed that the symmetric equilibrium following a single dropped out buyer from a multi-tasked English auction maximizes the seller's expected profit among all posterior implementable outcome functions [7]. Their paper demonstrated that, among all selling systems in which losers do not pay, the English auction fails to maximise the seller's expected revenue. To obtain the result, they assumed that there are only two bidders with private values  $u(\theta_i, \theta_{-i}) \equiv \theta_i$ ,  $i=1, 2$ . The primary finding appears to be that the English auction can only maximise the seller's projected profit provided the rules of all possible trade mechanisms allow each bidder to select his real payment conditional on the allocation of the object [8]. The seller does not maximize the interest if the rules of the transaction do not allow it or if the buyer is not sure of the actual terms of the payment. There are limitations to the sellers' ability to maximize their interests in an English auction.

When contrasted to the English auction protocol, the Dutch auction protocol operates in the other direction. The Dutch auction begins with a high price and progressively lowers it until a bidder expresses an interest in purchasing the products at that price. If no one bids on the item, the price

continues to fall until it hits the reserve price, below which it cannot go any more; in this instance, the auction is deemed a failure.

To conduct Dutch auctions effectively, the auctioneer must have a solid plan in place that guarantees the item is sold within a certain time frame and according to the seller's preferences. Their article employed the auctioneer's selling strategy, which is based on the concept of negotiation and decision functions provided by Faratin et al. to create bidding strategies in online auctions [9]. The authors of this paper used the values in Table I for their calculations. By analysing the price changes that occur as time changes in the auction and the number of similar products that appear in later auctions, they arrive at the following formula:

$$P_s(t) = \sum w_j(t) f_j(t). \quad (1)$$

In this formula,  $f_j(t)$  is the computed current selling price,  $w_j(t)$  is the weighting factor ( $0 \leq w_j \leq 1$ ) [10]. There is another formula that is based on a polynomial function developed from a negotiation system [11] and a strategy for online auctions [12], which is:

$$f_{rt}(t) = [k_{rt} - (k_{rt} - 1)(t/t_{max})^{1/\beta}] * Pr. \quad (2)$$

$f_{rt}$  represents the time left to sell the item. They found that an endless family of functions might be built by changing as indicated in Figure 1 and  $k_{rt}$ . By calculating the above two equations, Figure I is obtained. Figure I shows the present selling price when  $t_{max}=20$ ,  $pr=25$  and  $K_{rt}=5$ . To develop a solid selling strategy, one must explore such a space of functions for one that matches the present seller's preferences [10].

Overall, certain conditions need to be met if the seller's interest is to be maximised in English auctions. Benefits can only be maximised in an English auction if the bidder is able to choose their true price to pay based on the item. This limits to some extent the ability of sellers to maximise their interests in an English auction. In a Dutch auction, sellers who wish to maximise their profit need to take into account all aspects, arrive at a calculation model and maximise their profit by introducing a true value to calculate what the existing sale price should be. In any case, it can be difficult to use the model in real life, as many factors are difficult to measure numerically, such as the minimum price acceptable to the customer and the change in the customer's willingness to buy over the course of the auction, and a lot of statistics and research may be required to arrive at these precise values.

Table 2. Defining variables for polynomial functions [10]

Symbol	Meaning
t	The current universal time across all auctions.
T	A set of finite time intervals, where $t \in T$ .
$t_{max}$	The maximum time by which the auctioneer must sell the auctioned item or stop the auction.
$P_r$	Reserve price for the auctioned item; the minimum price that the seller is willing to accept for the auctioned item.
$P_s$	The current selling price; the selling price at any given time t ( $0 < t < t_{max}$ ). For a Dutch auction, $P_s$ decreases as the auction time progresses.
$k_{rt}$	Constant multiplied by the reserve price to determine the value of the auction's starting selling price considering the remaining time factor only. $k_{rt}$ must be equal to or larger than 1.
$\beta$	Different shapes of curve generated by varying the values of P which represent an infinite number of possible tactics for each value of $\beta$ .

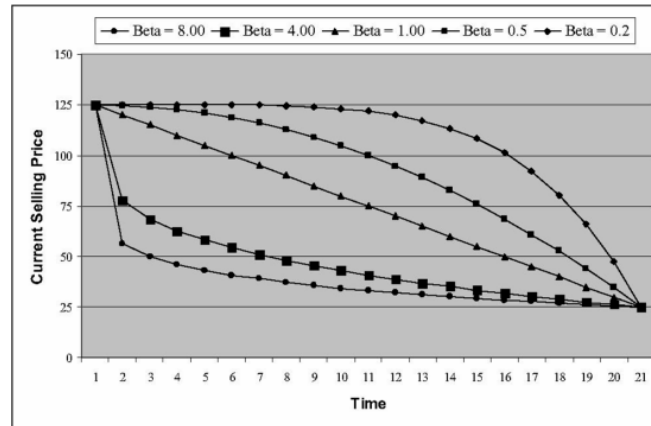


Fig. 1. Present selling value for the remaining term tactic with  $t_{\max}=20$  and  $p_r=25$  and  $K_{rt}=5$  [10]

## 6. Conclusion

### 6.1 Key findings

In the course of the study, this paper found that sellers' profits are closely related to different types of auction and consumers' preferences. By reading the literatures related to the analysis of the profit maximisation strategies for sellers in different auctions in recent years, this paper has organized and categorized the existing research results, and by comparing and analyzing the studies on maximizing profits of online auction sellers, we have indicated various ways to make sellers more profitable. Which mainly focuses on the English auction and the Dutch auction.

As for the paper's important findings about strategies to maximise profits in English auctions, firstly need to establish a trading program that serves to maximize the seller's profit. And find out what the seller's expected revenue is, in this case where it is assumed to know buyer information and preferences. In the general symmetric model, it is proved that if it's a multi-tasking English auction, then the seller's expected profit will reach the highest when appears a single dropped out buyer.

To obtain strategies that focus on Dutch auction, sellers need to research and use a specific function to match buyers' consumption preferences. This function ensures that the item is purchased at a particular time in the seller's interest. Therefore, according to this method, it is more convenient for sellers to intuitively understand how to use buyers' preferences to improve profits.

### 6.2 Limitations

For English auctions, theoretically the seller is able to maximise the profit when a bidder dropped out from a multi-tasked auction, but this only maximizes the seller's expectation of profit. Because in reality, there is finiteness of the situation, such as the bidder's payment allocation for each item.

When sellers choose Dutch auction, they can find the profit maximisation point through the function mentioned above, but the deficiency is that there is no real world data support and relevant research is limited.

The shortcomings of this paper are reflected in the lack of relevant research materials, and the inability to collect the actual online auction revenue data to emphasize the thesis.

### 6.3 Research significance

The Internet has made online auctions a popular way of trading. More academic attention has been paid to how to behave in an auction to maximise profits. Unlike many scholars who focus on how consumers benefit from the auction, this paper focuses on the seller. This paper is inspired by reading the literature related to how online auction sellers make profits. Therefore, sellers can try to achieve the profit maximisation by using the specific methods and practices summarized below. This provides some inspiration for novice sellers to start a business in the market, and can prevent sellers from quitting due to fierce competition rather than forming a healthy competition.

## 6.4 Future studies

Future research may expand to analyze how sellers choose their auction items. For example, auctioning multiple items together may attract a wider variety of bidders, leading to a higher closing price. Or how to increase consumer loyalty and satisfaction and attract more bidders. In addition to the product itself, customer service is also important. If there are many similar products in the market, consumers will choose to bid for the product offered by the seller with a better reputation.

## References

- [1] "Auction of Collectibles on the Internet". The New York Times. 23 May 1995. Retrieved 18 September 2019.
- [2] S. Klein and M. O'Keefe (1999). The impact of the web on auctions: some empirical evidence and theoretical considerations. *International Journal of Electronic Commerce*, 3(3), 7-20.
- [3] D. H. Reiley (2006), Field experiments on the effects of reserve prices in auctions: more Magic on the Internet. *The RAND Journal of Economics*, 37: 195-211. Available: <https://doi.org/10.1111/j.1756-2171.2006.tb00012.x>
- [4] E. B. Budish and L. N. Takeyama, Buy prices in online auctions: Irrationality on the Internet? *Economics Letters*, 72, 3(2001), 325-333.
- [5] T. R. Beavers (2014). Enhanced Online Dutch Auction with Seller Optimized Pricing Algorithms and Tabular Bidding Interface. US20140156438.
- [6] L. Yuan (2008). Analysis of Listing Price Option on E-Bay Market (Doctoral dissertation, Marshall University Libraries).
- [7] P. R. Milgrom and R. J. Weber (1982). A Theory of Auctions and Competitive Bidding. *Econometrica*, 50(5), 1089–1122.
- [8] G. Lopomo (2001). Optimality and robustness of the english auction. *Games and Economic Behavior*, 36(2), 219-240.
- [9] P. Faratin, C. Sierra and N. R. Jennings. "Negotiation Decision Functions for Autonomous Agents", *International Journal of Robotics and Autonomous Systems*, pp. 159-182, 1998.
- [10] A. N. AbuLaban and G. Z. Qadah, "Seller Strategies for Dutch Online Auctions", 2006 Canadian Conference on Electrical and Computer Engineering, 2006, pp. 505-509.
- [11] P. Faratin, C. Sierra and N. R. Jennings. "Negotiation Decision Functions for Autonomous Agents", *International Journal of Robotics and Autonomous Systems*, pp. 159-182, 1998.
- [12] P. Anthony and N. R. Jennings, "Developing a Bidding Agent for Multiple Heterogeneous Auctions", *ACM transactions on Internet Technology*, Vol. 3, No. 3, 2003, pp. 185-217.