

# Comparison of Four Basic Types of Auctions

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**Abstract.** Auction is a good way for people to exchange their goods and services and is essential to our daily life. Auctions can be classified into various genres and kinds depending on their unique rules. In this essay, I focused mainly on the four basic kinds of auctions: First-Price sealed-bid auction, Second-Price sealed-bid auction, Ascending-bid auction and descending-bid auction. I also tried to use several simple models to find out the characteristics and optimal strategies for each of the auction. Having their own advantages and weakness, different auctions should be used depending on specific situations to further maximize the efficiency of the auctions.

**Keywords:** Auction, First-Price sealed-bid auction, Second-Price sealed-bid auction, Ascending-bid auction, Descending-bid auction, optimal strategy, characteristics, application.

## 1. Introduction

Usually, the auctions can be divided into four basic types: Ascending-bid auction, Descending-bid auction, First-prize sealed-bid auction and Second-prize sealed-bid auction. Sometimes it would be hard for a person to find out the most efficient bidding rules due to different needs. As a result, analyzing each auction to learn more about its characteristic become particularly essential. In this essay, I attempt to analyze each basic auction to find out their optimal strategies and unique characteristics. I will then briefly introduce some specific applications and examples of these four basic auctions.

## 2. The optimal strategy for the four basic auctions

### 2.1. English auction (Ascending-bid auction)

The first basic auction is Ascending-bid auction. In an ascending-bid auction, the price raises successively until only one bidder is willing to pay. The bidder will win the auction and pays the final price. The ascending-bid auction also has a name called the English auction.

Let's assume there is an object that is being sold in an English auction. To make this model simpler, we can also assume there are only three bidders, bidder A, bidder B and bidder C, each with their own valuation  $a$ ,  $b$  and  $c$  ( $a < b < c$ ). they are all rational bidders and are intelligent enough to make the best decisions every time when they need to. They all want to get the object and have their own valuations. Each bidder only knows their own valuation. The auction starts. Due to the rule of the English auction, it starts with a really low price  $P_1$ . At this point,  $P_1 < a < b < c$ . Since  $P_1$  is lower than the evaluation of the three bidders, they all have preferences to bid on this product. Then the price goes up to  $P_2$  ( $P_2 = a$ ), thus for bidder A, he or she cannot gain a profit at this price. As the price goes even higher to  $P_3$  ( $a < P_3 < b < c$ ), bidder A will quit the auction. It is the same for bidder B as the price goes up to  $P_n$  that equals to his or her evaluation  $b$ : bidder B will also quit. In the end, it is obvious that bidder C will win the auction and pays the price of  $b$ .

In summary, in an English auction, the person with the highest valuation will get the object and he or she will pay the second highest valuation. In this kind of auctions, all the bidders just need to bid under their valuation and leave the auction if the price goes too high. This kind of auction is quite simple and easy to operate.

## 2.2. Dutch auction (Descending-bid auction)

In a descending-bid auction, the seller gradually lowers the price from some high initial value until the first time there is a bidder that accepts the price and pays it. Then the auction will end immediately. Let's assume there are  $n$  bidders who are willing to buy an object in a Dutch auction. At first, the price ( $P_1$ ) is extremely high, even higher than the highest valuation ( $a$ ) of the buyers. Since  $P_1 > a$ , no one accepts the price and the auction continues. Then, the price gradually lowers to  $P_2$  which equals to  $a$ . Still, there is no buyer that is willing to accept the price. As the price goes lower than  $a$ , more and more buyers are interested in the object, but they all do not know when to accept the price and end the auction. That's because they are struggling about how much they should shade their bids. Shading bids usually means to offer a bid that is lower than one's valuation to prevent overpaying. If the players shade their bids aggressively, they have bigger chances to win the Dutch auction, but they may gain less profits; if the players only shade their bids a little, they may lose the chance to win the auction. Thus, there are other factors that should be considered before the buyers shade their bids.

The auction would be more unpredictable and complex due to these unmeasurable factors. The factors can be the number of bidders, for example. As the number of bidders attending the same auction increases, the possibility for a certain bidder to win the auction would decrease and the less he or she should shade their bids. However, if there are fewer bidders in an auction, the bidder can shade his or her bid aggressively to gain higher profit. The bidders may also need to think predict the valuation of their competitors. If their competitors are wealthy people, it is more likely that they are willing to bid higher on the object. Conversely, if their competitors are not wealthy enough, the bidder can bid aggressively.

## 2.3. First-price sealed-bid auction (FPSB)

Different from the English auction, the first-price sealed bid auction enables each buyer to write down their bids secretly on a piece of paper or submit their bids in a way without letting other player know their bids. After all the bids are collected, the person with the highest bid will win the auction and pays the bid he or she submits. Same with the English auction, the first-price sealed auction also needs the bidders to shade their bids.

In order to gain a positive profit, all the players also have to shade their bids while they are participating in a First-price sealed auction which makes this auction more similar to the Dutch auction.

## 2.4. Second-price sealed-bid auction (SPSB)

The last basic auction is the Second-price sealed bid auction or SPSB. In a Second-price sealed bid Auction, each bidder will write down their own bids on a piece of paper or something else and then hand in the paper (Same with the FPSB). The bidder with the highest bid will win the auction and pay the second highest bid. In this auction, the person with the highest valuation gets the object and pays the second highest valuation. Since the rule is slightly different with the FPSB, there may be some people wonder that the bidders may not bid the true valuation to get higher profits or winning possibilities. However, if all the bidders are rational bidders, we do not need to worry that the buyers will not bid their true valuation.

Here is a simple model for SPSB. Let's assume there is a player A that has a valuation of  $a$  towards the object that is being sold in the SPSB. Player B (has a valuation of  $b$ ) is the buyer with the highest valuation among other players. Same with the model of the English auction, both player A and player B are rational and intelligent bidders.

We can divide the situations into two parts depending on the behaviors of player B.

a. If player B is wondering between to bid lower and to bid the truth. There are three possibilities.

1.  $b$  (the valuation of player B)  $>$   $a$  (the valuation of player A)

1) Bid lower: player B can get a surplus of 0.

2) Bid the truth: player B can also get a surplus of 0.

Bid lower and bid the truth are equally good.

2.  $PL$  (the price of player B bidding lower)  $< b < a$ 
  - 1) Bid lower: player B can get a surplus of 0.
  - 2) Bid the truth: player B can gain a profit of  $(a-b)$ .

Bid the truth is better than bid lower.

3.  $b < PL < a$ 
  - 1) Bid lower: player B can get a surplus of  $(a-b)$
  - 2) Bid the truth: player B can get a surplus of  $(a-b)$

Bid lower and bid the truth are equally good.

Thus, by considering the three possibilities above, we can get the conclusion: Bidding the truth is better than bidding lower than the bidder's valuation.

b. If player B is wondering between to bid higher and to bid the truth, there are also three possibilities.

1.  $b$  (the valuation of play B)  $> Ph$  (the price of player B bidding higher)
  - 1) Bid higher: player B can get a surplus of 0.
  - 2) Bid the truth: player B can also get a surplus of 0.

Bid higher and bid the truth are equally good.

2.  $Ph > b > a$  (the valuation of player A)
  - 1) Bid higher: player B can get a negative surplus of  $(Ph-b)$ .
  - 2) Bid the truth: player B can get a surplus of 0.

Bid the truth is better than bid higher.

3.  $Ph > a > b$ 
  - 1) Bid higher: player B can get a positive surplus of  $(a-b)$ .
  - 2) Bid the truth: player B can get a positive surplus of  $(a-b)$ .

Bid higher and bid the truth are equally good.

All in all, bidding the truth is better compared to bidding higher than the bidder's true valuation.

From the previous analyzation, it is obvious that for rational buyers, the best strategy for them in a Second-price sealed auction is to bid on their true valuation. Only by doing that, can they maximize their profits and avoid unnecessary loss.

### 3. comparison among four basic auctions

Although the rules for these four basic auctions are different, there are a lot of similarities in some of their optimal strategies. For both the English auction and the Second-price sealed-bid auction, the optimal strategies are equivalent. For the buyers, all the things they need to consider is to bid based on their true valuations. They do not need to predict or struggle with how much they should bid. They can only focus on themselves. For example, in English auction, the buyer can bid until the price reaches his or her valuation. In the SPSB, writing down their true valuation and wait for the result is the only thing buyers need to do.

For both Dutch auction and First-price sealed auction, however, the buyers have to predict other bidders' behavior to win the auction. In these two auctions, shading bids is necessary for the bidders and they must choose the right equilibrium moment to set their bid. Bidding too high or too low would influence their results. The bidders also need to consider various and complex factors.

#### 4. Advantages and disadvantages for four basic auctions

Table.1.the advantages and disadvantages of the four basic auctions

	<b>Advantages</b>	<b>Weakness</b>
<b>English auction</b> (Ascending-bid auction)	1. Completely transparent and open: bidders can gain information about their competitors during the auction. 2. Easy to operate	1. Suffers from the Winner's curse which is that the bidders may bid more than their private valuation
<b>Dutch auction</b> (Descending-bid auction)	1. Enable small investors to participate in the auction 2. The auction usually ends in a shorter period of time	1. More complex and unpredictable
<b>First-price sealed-bid auction (FPSB)</b>	1. Maximize the profit of the bidders	1. Suffers from the Winner's curse 2. More complex and unpredictable 3. Bidders may bid lower than its actual value
<b>Second-price sealed-bid auction (SPSB)</b>	1. Reveal the true valuation of the bidders 2. Easier for the bidders since they only need to focus on themselves	1. Cannot gain a lot of profits

#### 5. Applications and variants of the four basic auctions

##### 5.1. English auction

English auctions can be used for many kinds of products and objects. That's because this kind of auctions, as we have mentioned in the precious paper, is easy to operate and is relatively simple. There are two kinds of English auctions which are traditional auctions and online auctions. The traditional English auctions usually do not need to schedule specific time and the auctions usually last for only a few minutes. However, as technology developed, a new kind of English auction emerged. The new kind of English auction is hold online and one of the most common examples is the online auction hold on Ebay. The auctions usually last for a week. Some bidders found a bidding strategy which is called the bidding snipping. When the bidders are applying this tactic, they place a bid higher than the current bid just seconds before the auction ends which can prevent the bidders with higher bids to win the auction. If the bidders want to win the auctions, they can use the automatic bidding in Ebay to set a highest price that they can accept. eBay will automatically place bids for the bidders. The platform will continue to do this until the bidders' caps have been reached.

English auctions have a lot of variants. A few examples of these variants would be the English clock auction. In the English clock auctions, the price also starts from a low price and then raises gradually as the time pass. The bidders can signal the auctioneers when they decide to drop out of the auction. Once the bidder quit the auction, he or she cannot come back later. Finally, the only bidder who remains will win the auction and pays the highest price. The second variant would be the Time-interval auction. Time-interval would refer to the English auctions consume days or weeks to complete. This variant is used in the real-estate and manuscript markets. Ebay is also an example of this kind of variant. Instead of the strategy of bid snipping, bidding high until the last moment, there is another strategy that is being widely used in the Time-interval auction. Unlike the bid snipping, the bidders may offer a relatively high bid at the beginning of the auction to scare of other competitors.

## 5.2. Dutch auction

For the Dutch auctions, they are usually used for objects that cannot be preserved for a long period or are changeable as time passes. These kinds of products include flowers, fruits, vegetables, fishes and so on. Dutch auction usually ends in a short period of time which makes it a perfect auction for the products that need to be sold immediately. In Dutch auction, the host may use a clock during the auction. A classic example of this kind of auction would be the Aalsmeer Flower Auction. At first, the hand on the clock starts at the top, at the beginning price, and moves counter-clockwise to lower prices. The person who pushes the button to stop the clock uses a microphone to inform the staff the quantity he or she wants. Then, the hand goes back to a higher price and moves counter-clockwise again until the next bidder pushes the button. The auction can end quickly. In fact, the Aalsmeer Flower Auction has 13 clocks in five auction rooms, with each price clock yielding a transaction price every few seconds. It is this efficient auction method that enable Netherlands to export flowers and pot plants in many other parts of the world and become the world center of flower and plant trade.

## 5.3. FPSB and SPSB

Since the sealed-bid auctions can give auctioneers more choices and control over the whole auctions, they can be used for more formal and important situations. They can have more time and chances to consider. For the first-price sealed-bid auction, it is used for refinancing credit and foreign exchange. The U.S. Treasury uses the discriminatory auction to sell most of the treasury bills, notes, and bonds that finance the national debt of the United States. the first-price sealed-bid auctions can also be used for award construction contracts. The bidders can give their own construction plans and designs to the auctioneers, also the buyers, and the auctioneers will give the sign the contracts with the company or bidder that give the best plan or design. In Japan, this kind of auction is used to sell dried fish. The second-price sealed-bid auctions can also be used in selling national debts and share some similar applications with the first-price sealed-bid auctions.

## 6. Conclusion

Each of the four basic auctions has its unique auction rules and optimal strategies. English auction and SPSB share similar strategies, while the Dutch auction and FPSB have equivalent strategies. These four auctions all have their own advantages and drawbacks and should be used depending on specific situations. English auctions are relatively simple and easy to conduct and thus can be used for various purposes in different fields; Dutch auctions' unique rules enable them to end in a short period time and thus are used for selling products that cannot sustain for a long time such as flowers; The first-price sealed-bid auctions and the second-price sealed-bid auctions share some similar applications and can be usually used for selling national debts and awarding construction contracts. Although I only introduce the rules, strategies, characteristics and applications for these four basic types of auctions, there are countless other auctions that are far more complex. Only by learning more and analyzing more about the auctions can we find out the most suitable auctions for different trades and purposes.

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