# Common Value Auctions With Proprietary Information:

# A Field Experiment

by

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ABSTRACT

We offer experimental evidence from the field on bidding behavior and seller revenue in a common value auction in which insiders have perfect knowledge of the true value of the object and outsiders only have public information about the true value. This variant of common value auctions has quite different theoretical predictions than the variant in which symmetric outsiders each have private information. It corresponds to the early theoretical literature on common value auctions, and applies to many naturally occurring settings (e.g., financial markets). We find that theory adequately organizes the observed behavior. Our results also have practical implications for revenue-maximizing sellers of goods and services.

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Common value auctions describe a setting in which there is one true value for the object that is being sold, but differential *ex ante* information about it's value. In one canonical case each bidder receives a private signal that is known to be correlated with the true value, but all bidders are symmetrically informed. We refer to this as a Symmetric Information Structure (SIS). In another case, with clear relevance to financial markets, one "insider" is significantly better informed than other bidders. In the extreme, assume that insiders have perfect knowledge of the true value. Early theoretical models by Wilson [1967], Weverbergh [1979], Engelbrecht-Wiggans, Milgrom, and Weber [1983] and Hendricks, Porter and Wilson [1994] studied this Asymmetric Information Structure (AIS) and assumed that outsiders only have public information. Thus the insider has a "double informational advantage," to use the expression of Kagel and Levin [1999; p.1219]: they not only have better information about the value of the object, but they know what every other bidder knows. One might add a third cognitive advantage, since they also know that all outsiders are identically informed.[1]

We study the behavior of bidders in common value auction experiments of this type, in which the insider is "well informed" in the manner described. Previous laboratory experiments with student subjects have considered the SIS case (Kagel and Levin [2002]), and the AIS case in which outsiders receive private information which is simply not as precise as the information received by the insider (Kagel and Levin [1999]).This AIS case corresponds well to the naturally occurring setting of auctions for tracts of land expected to contain oil and gas. In such settings each firm can be expected to have processed some geological information and draw inferences that are positively correlated with the true geological outcome. Alternatively, our AIS case corresponds well to call

[1] One could imagine a setting in which N-1 outsiders receive N-1 private signals about the value of the object and the outsider knows each of those N-1 bits of information.

markets for stock, in which insiders enjoy proprietary information and outsiders have to rely on public information such as accounting statements files with the Securities and Exchange Commission.

The relevance of field subjects and field environments for tests of the properties of common value auctions is clear, but to our knowledge not studied in a controlled field setting with natural asymmetries. We study the behavior of insiders in their field context, while controlling the "rules of the game" to make their bidding behavior fall into the domain of existing auction theory. In this instance, the term "field context" means the commodity and institution for which they are familiar as well as the type of bidders they normally encounter. We also study the type of asymmetric common value auction that we believe to be appropriate for financial markets, where the vast bulk of traders rely on public information.

We employ "framed field experiments" in which we use a commodity that subjects naturally trade in the setting that we conduct the experiment.[2] We are also able to identify naturally occurring traders who have more experience in these markets, and that would be viewed as the field counterpart of traders with proprietary information. We find that while previous research suggests that structural and institutional features of the market are important, our results indicates that market composition also has important influences on individual behavior and market outcomes. For example, bidding behavior of both well informed and less informed agents critically depends on their beliefs about the nature of their competitors. This change in bidding behavior in turn significantly influences expected seller revenues. These results speak to a previous literature that explores private and public financing (see, e.g., Rajan [1992] and Subrahmanyam and Titman [1999])

[2] The term "framed field experiment" is due to Harrison and List [2004], and in this context refers to a field experiment in which the commodity and traders occur naturally.

and bidding in debt auctions (see, e.g., Hamao and Jegadeesh [1998]). Viewed more broadly, our study showcases an interesting new tool available to scholars, field experiments, that represents a useful compromise between uncontrolled field data and laboratory experiments using student subjects.

The next section discusses our theoretical predictions and previous related research. Section 2 summarizes our experimental design. Section 3 summarizes our results, and Section 4 concludes.

## 1. Theoretical Predictions and Previous Experimental Evidence

Economic theory provides game-theoretic predictions of behavior in first price common value actions. Let AISpr and AISpu denote the AIS setting in which the outsiders have private or public information, respectively. We focus on two predictions from the literature which assumes bidders employ symmetric Nash equilibrium strategies:

1. *Expected Seller Revenue.* Expected seller revenue in the AISpr setting *exceeds* expected seller revenue in comparable SIS settings, even though it is known to be *lower* in the AISpu setting compared to SIS. Thus, privacy of the outsider's information makes a difference from the perspective of the seller.
2. *Informational Rents to Outsiders.* Outsiders earn *positive* informational rents in the AISpr setting, albeit *less* than they would earn in the SIS setting.[3] Outsiders should earn *zero* informational rents in the AISpu setting.[4]

We empirically evaluate these predictions using field experiments in which traders have home-grown

[3] Unless otherwise noted, all claims about expected rents or expected profits are conditional on winning. Expected profit is zero, by design, conditional on not winning.

[4] This result is proven in Engelbrecht-Wiggans, Milgrom, and Weber [1983; Theorem 2], who note that it is more general than the specific assumptions normally used in the auction literature.

values for an object. Other predictions exist, but are outside of the scope of our experimental design.[5]

In AISpr auctions, Kagel and Levin [1999] use laboratory experiments with student subjects, and find that inexperienced bidders overbid relative to the theoretical prediction, and that virtually none of the theoretical comparative static predictions comparing AIS and SIS hold. Thus, adding an "insider" with better information about the true value of the object does not lead to a large enough reduction in over-bidding relative to predictions such that the predictions of theory are confirmed. Behavior is substantially more consistent with "super-experienced" bidders, who exhibit far less over-bidding behavior, and for these bidder types virtually all of the predictions of theory are supported. In their laboratory settings, super-experienced means that the subject had participated in at least two previous experiments with first-price common value auctions and the same number of bidders. Furthermore, no bidder who went bankrupt in early trading in the prior experiments was recruited into the super-experienced pool. Nor would one expect traders who made tiny profits to volunteer to return.

Our experiment is designed to focus on the differences identified by Kagel and Levin [1999] between "inexperienced" and "super-experienced" bidder behavior, particularly when "insiders" are added to the mix. Our field setting provides an opportunity to define these terms in a manner that is more natural and role-specific than normally encountered in a traditional lab environment with student subjects.

[5] Complementary laboratory experiments, in which one induces values over an abstract commodity, would allow one to test the remaining predictions. Harrison and List [2005] undertake such experiments, and find evidence that the theory organizes the main predictions well.

## 2. Experimental Procedures

We recruit subjects from a well-functioning marketplace, the floor of a sportscard show, using essentially the same general procedures explained in List and Lucking-Reiley [2000] and List [2001]. All experiments were run in Tucson, Arizona. The advantage of this field sample is that we can readily identify individuals who are "dealers" and those who are "non-dealers." We take the dealers to be the informed bidders since they have vast experience in bidding in such auctions and understand the nature of the good. "Non-dealers" are the lesser informed bidders, or "outsiders."

Subjects are asked to bid on a commodity that is familiar in this field setting. Each subject's participation followed four steps: (1) inspection of the good, (2) learning the rules, (3) bidding, and (4) conclusion of the transaction.

In step 1, a potential subject approached the experimenter's table located on the floor of a sportscard show, and inquired about the sale of the 1990 unopened pack of *Leaf* Series 1 wax baseball cards displayed on the table. An unopened pack of 1990 *Leaf* baseball cards retailed for about $10 at the time of the experiment. Each pack could contain thousands of dollars of sportscards. The pack is sealed by the factory, and has not been opened. This characteristic, coupled with the fact that subjects informed us that they planned to open the pack and sell its contents if they were deemed winners, provides our field auctions with a common value component. Our knowledge of this market makes it clear that experienced traders know the common value aspect of an unopened pack of cards, and indeed many have participated in unopened pack auctions. Previous experimental auctions with sportscards, such as List and Lucking-Reiley [2000] and List [2001], deliberately used actual cards and not packs of unopened cards, so that their experiments could be viewed as private value auctions.

Furthermore, the company producing the pack, *Donruss*, goes to great lengths to ensure that

the "collation" of cards is random. In fact, the collation is so good that each pack is effectively a random sample without replacement in our experience. There are 264 cards in the 1990 *Leaf* set, and 10 cards per pack; each "set" refers to a group of players included in the production run. Thus, since Sammy Sosa's rookie card is in the *Leaf* set, there is a 10/264 = 0.038 probability of getting a Sosa card in the auctioned pack. A Sosa card in Gem-Mint condition retailed for more than $350 at the time of our experiment.

As mentioned above, all participants stated that if they won the auction they planned to open the pack. Thus they each have their own private signals about the various probabilities of any given card being included in the pack and the total value of the cards in the pack. The experimenter then invited the potential subject to take about five minutes to participate in an auction. If the individual agreed to participate, he could pick up and visually examine the unopened pack. The experimenter worked one-on-one with the participant, and imposed no time limit on his inspection of the cards.

In step 2 the administrator gave the participant an instruction sheet that consisted of the auction rules for a standard first price sealed bid auction. This instruction sheet is reproduced in Appendix A. Several examples of the auction were carried out to ensure that a wide range of subjects would understand the auction rules. No decisions were made until the subject fully understood the rules and her task. Each subject was informed about the number of other bidders in their auction.

After having her questions answered, in step 3 the participant placed her bid on the sheet provided. Finally, in step 4 the experimenter explained that the subject should return at a specified time to find out the results of the auction. Transactions took place at 6p.m. on Saturday and Sunday. If a subject did not return for the specified transaction time, she would be notified; after we had received her payment, she would receive her unopened pack of cards within three days via standard postal service, with postage paid by the experimenter. All winners paid, as agreed.

Again, no subject participated in more than one treatment, and subjects were randomized into treatments by changing the treatment every hour. Hence, subjects' treatment type was determined based on the time they visited the table at the card show.

We examined the natural counterparts of the SIS and AIS conditions. Specifically, in the field SIS condition, dealers are paired with dealers and non-dealers are paired with non-dealers, and everyone is informed of this composition. In the field AIS conditions we matched three non-dealers with one dealer, and again everyone is informed of this fact.

The public signal in the field AISpu treatments is *a list of the potential cards in the pack and their associated, estimated probabilities*. Specifically, we provided a list of the cards potentially in the *Leaf* pack to each bidder, the associated probabilities of obtaining one, two, three, etc. of any one given card, and the most recent book values of each card. All of the field treatments used N=4, and were one-shot, since that is the bilateral, "one-on-one" trading context typically encountered in the field. We collected data from 64 bidders in the SIS treatment, spread over 16 different auctions of N=4 bidders. We collected data from 60 bidders in each of the AISpr and AISpu treatments.

## 3. Results

We examine bids and revenues to gain insights into whether the theoretical predictions are met. Figure 1 displays the bid distribution in the SIS, AISpr, and AISpu treatments for dealers and non-dealers, Figure 2 displays the average revenue in each treatment, and Figure 3 displays box plots of the distribution of seller revenues.

A vertical comparison of the bid distributions in Figure 1 reveals that *dealers generate lower bids than non-dealers in the same setting*. This result holds in each of the three treatments. Moreover, from the horizontal comparison of the bid distributions we see that non-dealers bid more aggressively when

an insider is added. These conclusions are supported when we estimate the bid model Y = f(X), where Y is subject i's bid and X includes subject type, treatment indicators, and their interaction. We use a Tobit specification to account for the censoring caused by the zero bids in the data.

Summary estimates are presented in Table 1. The empirical results provide several interesting insights. First, using a one-sided alternative, well informed bidders shade their bids to a greater extent than lesser informed bidder types at the $p < 0.05$ level. The level of shading is also of note: dealers submit bids roughly 30% (= \$1.26 ÷ \$4.31) lower than their non-dealer counterparts. Second, in the AIS auctions, the less informed bidders considerably increase their bids compared to bidding distributions in an environment of symmetrical information. For example, in the AISpr setting, on average non-dealers bid \$5.96 (= \$4.31 + \$1.65), or nearly 40% more than they bid in the SIS setting. Thus, by simply replacing one lesser informed bidder with a more informed bidder, the three remaining lesser informed bidders react by considerably increasing their bids. This result, which is significant at the $p < 0.02$ level using a two-sided alternative, is consistent with the prediction that outsiders in the AISpr setting earn less informational rents than they earn in the SIS setting. A similar, though slightly less compelling, finding holds for the bid comparisons across the SIS and AISpu settings: lesser informed agents in the AISpu auctions increase their bids by roughly 30% (= \$1.25 ÷ \$4.31), an increase that is statistically significant at the $p < 0.08$ level.

Third, empirical results for more informed bidders provide evidence of the sophistication of these bidder types. As Table 1 indicates, well-informed agents in the AIS auctions bid considerably higher than they bid in the SIS auctions. Consider the AISpr auctions: on average, dealers bid \$3.67 (= \$4.31 - \$1.26 + \$1.65 - \$1.03), an increase of 20% over their SIS average bid of \$3.05 (= \$4.31 - \$1.26). Hence, well informed bidders bid differently when competing against lesser informed bidders. This difference is not statistically significant at conventional levels, but directionally it

suggests that dealers are well aware of the differences in bid strategies between informed and lesser informed bidder types. Similar insights are obtained in the AISpu auctions, where the well-informed bidder types submit much higher bids than they submit in the SIS auctions. In this case, the difference of \$1.18 is significant at the $p < 0.22$ level, using a two-sided alternative.

While the treatment effects on individual bidding levels certainly suggest that revenues should increase when moving from the SIS auctions to the AIS auctions, the first price auction pricing institution does not ensure this outcome. Figure 2 displays the average seller revenue across the field treatments, which is the relevant metric for a risk-neutral revenue-maximizing seller. There is a large and significant increase in seller revenue in the AIS treatments compared to the SIS auctions with dealers, but not with respect to the SIS auctions with non-dealers. This result is consistent with the evidence from Table 1 that dealers shave their bids significantly more than non-dealers in common value settings. Risk averse sellers would also be interested in the variance in revenues. Figure 3 displays information on the median, interquartile range, and range of revenues observed. Non-dealers exhibit higher variance in the SIS setting compared to dealers, and there is a slight decrease in revenue variance in the AIS setting as one adds public information.

Overall, these results lend insights into expected seller revenues under alternative auction scenarios. While revenues are not considerably different across the AISpr and AISpu auctions, we find evidence that the AIS settings outperform the SIS auctions with only informed bidders as competitors. This result holds because the intermixing of bidder types induces both insiders and outsiders to increase their bids. This fundamental insight is important in both a positive and normative sense. In practice, this result highlights the point that bidder composition in common value auctions is an important consideration for revenue-maximizing sellers.

## 4. Conclusion

Using framed field experiments, we evaluate bidding behavior and seller revenue predictions for common value auctions with insiders who have proprietary information. We find that theory organizes the observed behavior well. More generally, this study highlights how field experiments can be used to further our understanding of important, and previously unaddressed, issues regarding financial markets. Undoubtedly, powerful insights can be gained from both uncontrolled field data and laboratory experiments using student subjects and induced values. Yet, our approach provides a practical middling ground that makes use of the most attractive elements of each of these approaches: exogeneity of treatment and observing behavior in a naturally-occurring environment. While our research represents a necessary first step in the discovery process, we hope that future efforts will explore more fully other potentially important issues using controlled field experiments.

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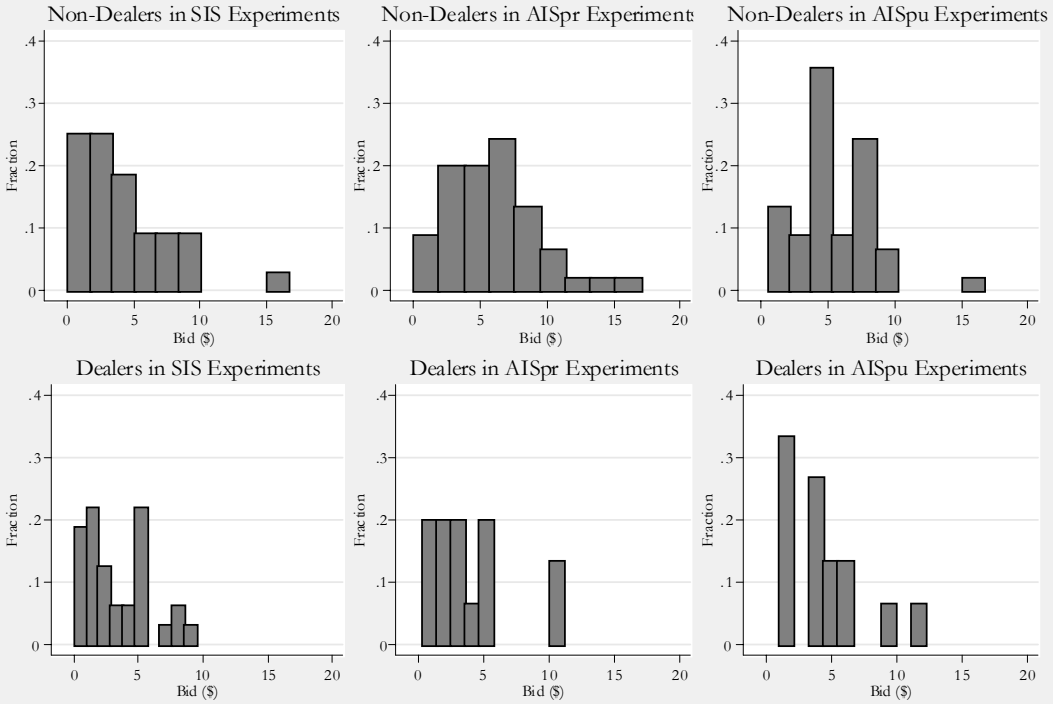
## Figure 1: Bids in Field Experiments




## Figure 2: Average Seller Revenue

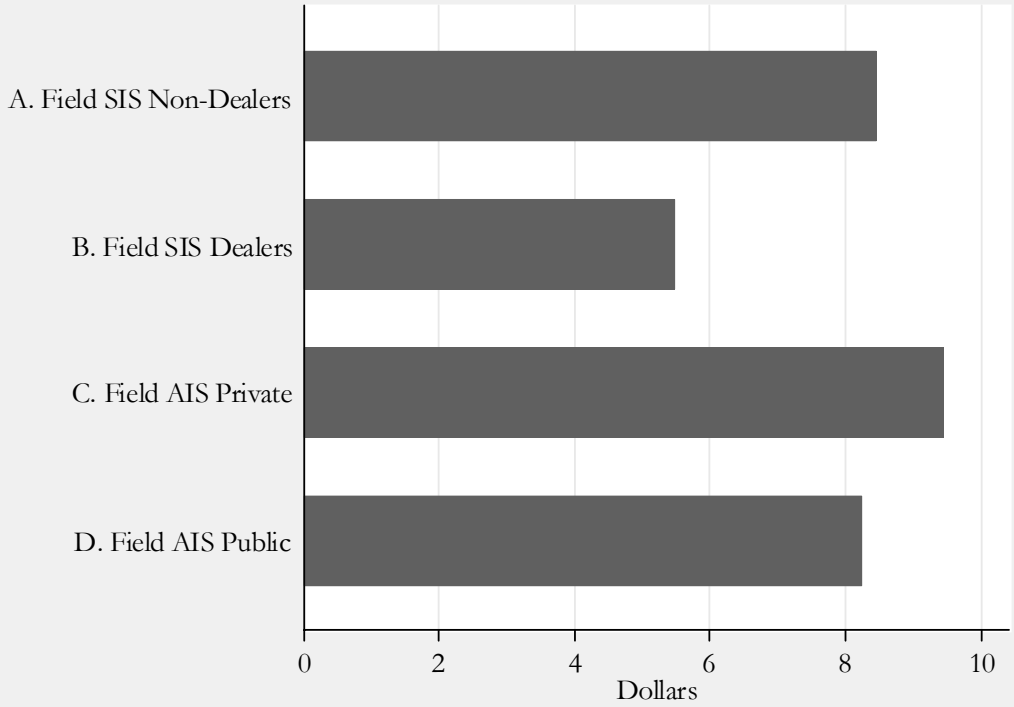


Figure 3: Box Plots of Seller Revenue

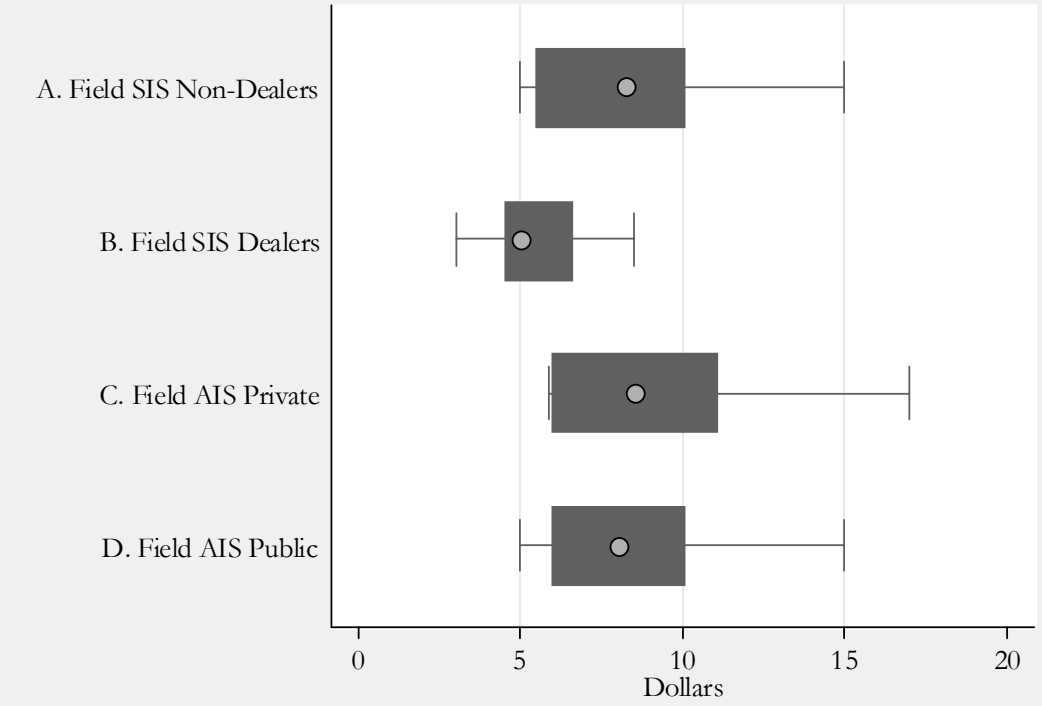



**Table 1: Bid Regressions**

Tobit specification used, with censoring at $0

| Variable | Description | Point Estimate | Standard Error | *p*-value | Lower 95% Confidence Interval | Upper 95% Confidence Interval |
|---|---|---|---|---|---|---|
| | Constant | 4.31 | 0.54 | 0.00 | 3.25 | 5.38 |
| Dealer | Dealer | -1.26 | 0.77 | 0.10 | -2.77 | 0.25 |
| AISpr | Asymmetric Private Information | 1.65 | 0.71 | 0.02 | 0.25 | 3.04 |
| AISpr_D | Asymmetric Private Information × Dealer | -1.03 | 1.19 | 0.39 | -3.38 | 1.32 |
| AISpu | Asymmetric Public Information | 1.25 | 0.71 | 0.08 | -0.14 | 2.65 |
| AISpu_D | Asymmetric Public Information × Dealer | -0.07 | 1.19 | 0.96 | -2.42 | 2.29 |
| | Standard error of the regression | 3.06 | 0.16 | 0.00 | 2.74 | 3.38 |

## Appendix A: Subject Instructions

[These instructions are for the symmetric field auctions with 4 participants.]

Welcome to Lister's Auctions! You have been invited to participate in an auction for the unopened pack of 1990 *Leaf* cards displayed on the table. I guarantee to sell the unopened pack to the highest bidder, no matter how low the price. You will be bidding against 3 other bidders in this auction, but you will not know their identities (nor will they know yours); the other bidders will be randomly chosen from other participants at today's card show. If you are a card dealer you will be paired randomly with three other card dealers. If you are not a dealer, you will be paired with three other non-dealers.

This is a first-price sealed-bid auction. In a first-price auction, the person with the highest bid wins the good and pays the amount of his or her bid. For example, I will order the four bids from highest to lowest in order to determine the winner.

Example 1: if the bids are ranked highest to lowest as follows:

$A (from bidder 3)
$B (from bidder 4)
$C (from bidder 1)
$D (from bidder 2)

Bidder 3 wins the unopened pack and pays $A. Would you like to proceed through another example? {If "yes", then show another example}

There is no secret "reserve price." The pack will be sold to the highest bidder, no matter how low the price.

Your bid represents a binding commitment to pay for the pack according to the rules of this auction. I will determine the winner at 5PM today. After the winner pays me (cash or check) for the pack, the pack will be awarded to the winner. If you win the pack in this auction and are not in attendance at 5PM, it will be sent to you via first-class mail upon the receipt of your payment. There is no charge for shipping.

Please provide your name, mailing address, and phone number below:

Name_____

Address_____

Phone#_____

Email_____

Signature_____

Good luck - please write your bid on the sheet provided. Thanks for participating.