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THEORIES AND TESTS OF "BLIND BIDDING" IN SEALED BID AUCTIONS

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Auctions are a ubiquitous method of allocating resources. While auctions share many common characteristics, there are some features which distinguish among them. One such difference is the information that the seller and the buyers have about the quality of the item(s) at auction. In many cases, the seller of the item has better information about the quality of the item than any of the potential buyers. If buyers knew this information, they would be able to more accurately determine their valuations for the item. While a seller may choose to reveal his information to the buyers, it may not always be in a seller's best interest to do so; instead, he may decide to "blind bid" his item. In this paper, we will develop several competing predictions regarding blind bidding behavior and report the results of an experiment which was designed to test these predictions.

The institution of blind bidding has recently become a matter of controversy in the motion picture industry. A distributor of a film conducts an auction in which motion picture exhibitors (owners and/or operators of movie theater houses) can obtain the rights to exhibit the film. While distributors could permit exhibitors to screen the film prior to submitting their bids, they instead commonly choose to blind bid their product. Since 1977, however, many states have passed laws outlawing the practice of blind bidding. These laws have been supported by the exhibitors but have brought heated objections from the motion picture industry, including threats to discontinue location filming

in states which adopted them.[1]

In what follows, we do not restrict ourselves to the motion picture industry specifically since the issues we address are present in any auction where a seller may, at his discretion, provide potential buyers with useful information about the quality of the item for sale. Nonetheless, our results may be of particular significance for the case of the motion picture industry since we do present a theoretical and experimental analysis of market performance in sealed-bid auctions in which the sellers may optionally blind bid the object they have for sale.[2]

We consider a model which is a special case of a class of "persuasion games" which has been analyzed in Milgrom [1981] and Milgrom and Roberts [1986]. In our model, there are several Nash equilibria which may arise. In one of them, all items are blind bid since buyers ignore all information provided by a seller and the seller offers no information since what he says is irrelevant. In another equilibrium, no items are blind bid since buyers adopt a skeptical "assume the worst" strategy about a seller's announcement and thus a seller can never do better than to reveal his information to the buyers. If we restrict our attention to sequential equilibrium as introduced by Kreps and Wilson [1982], only the second of these two Nash equilibria is also sequential. A sequential equilibrium requires each buyer to make conjectures which are consistent with a seller's announcement strategy. Since the Nash equilibrium in which the buyer ignores the seller's announcement requires that each buyer

[1] See Harris [1981], Kenney and Klein [1983], and the note in Harvard Law Review [1979].

[2] Since completing our experiments, we have become aware of a paper by King and Wallin [1986] who consider similar issues in a competitive double auction market for risky assets. Their findings seem generally consistent with ours although they consider different alternative disclosure rules.

disregards a seller's motives when considering the seller's announcement, this cannot be a sequential equilibrium.

We also use the sequential equilibrium model of the persuasion game to provide some results concerning the way in which an equilibrium is attained. As long as at least one buyer adopts an unsophisticated strategy about the seller's announcement and acts as if this information had been provided by a disinterested party, a seller will adopt an announcement strategy that maximizes the price he receives from the unsophisticated buyer. Since even unsophisticated buyers are responsive to favorable information in a sequential equilibrium, a seller will reveal his information if it is very favorable and will make noninformative announcements otherwise. When the seller does not reveal his information, an unsophisticated buyer will be the high bidder for the item since he will average over all possible quality levels for the item instead of assuming the worst. We show that as buyers become increasingly sophisticated, a seller reveals his information for units of increasingly lower quality levels. In this way, the market behavior will "unravel" to the predicted sequential equilibrium.

The remainder of this paper is organized as follows. In the next section we present our model of a persuasion game and derive testable predictions. In section II, we present a description of the laboratory markets we conduct along with formal statements of the specific hypotheses we wish to test. Our results are described in section III and we provide a summary along with some concluding remarks in section IV.

I. The Model

In this section we borrow heavily from Milgrom and Roberts [1986]. Consider a game with a single seller and n buyers. The seller knows the quality of the single item he has for sale and he can provide verifiable information about the item's quality to the buyers. For simplicity, we consider only the case where the seller must decide whether to announce his item's quality. If he does announce the quality of the item, his announcement must be truthful. All buyers receive this information; the seller cannot selectively reveal the item's quality to some, but not all of the buyers. After buyers observe the information provided by the seller, the item is auctioned off in a first-price sealed bid auction. The seller tries to maximize the price he receives for his item, while each buyer wishes to maximize his expected profits which are given by his expected valuation for the item less its purchase price. Each buyer's expected valuation for the item depends upon its quality, the information disclosed by the seller, and the inferences the buyers make from this disclosure.

This problem can be represented as an auction in which the object being sold has a common value component and a private value component. Specifically, we assume that these components are additive, so that if a buyer wins the (first-price) auction with a bid, b_i, and the common and private values of the object are, respectively, q and v_i, then that buyer receives a utility equal to $U_W(b_i, c, v_i) = q + v_i - b_i$. If the buyer does not win, he receives utility U_L = 0. It is common knowledge that the set of possible values of q, denoted Q, is finite with possible values $0 < q_1 < q_2 < . . . < q_S$, where $q_{k-1} - q_k = q_1$, for k = 1,...,S-1. The probability that a seller is endowed with a particular "quality level" (i.e. common value component) is 1/S. Further, for each k, each buyer's private valuation, v_i^k, is independently drawn from a uniform distribution on $[0,q_1]$. Consequently, conditional on common quality level q_k, buyers' combined common and private valuations $(q_k + v_i^k)$ are independently and identically distributed on the interval $[q_k, q_{k+1}]$. The initial structure of private information is that the seller knows q_j and each buyer i knows v_i^k, for each k.

The game proceeds in two stages. In the first stage, the seller observes the quality, q_j, of the object he has for sale and makes a public announcement from the set $A = (q_j, \bar{Q})$. In other words, the seller either precisely reveals the quality or reveals no information at all. After the announcement, a sealed-bid first-price auction is conducted.

To define an equilibrium to this game we specify an announcement strategy for the seller, $a(\cdot)$, which maps Q into A; a belief function for each buyer, $\beta_i(\cdot)$, which maps A into probability distributions on Q; and a bidding strategy which maps A x $[0,q_1]$ into $\Re_+$. Because announcements must be truthful, $\beta_i(\cdot|a=q_j)$ is a degenerate distribution at q_j. Thus, we only need to consider beliefs in the second stage for the case in which the announcement is $\bar{Q}$ ("noninformative").

There are several Bayesian Nash equilibria to this game. Two extreme versions provide some idea of the range of possibilities. At one extreme is an equilibrium supported by what Milgrom and Roberts have called "naively credulous" beliefs when the announcement is Q. At this equilibrium, Q is always announced and the buyers take this at face value and do not update their prior beliefs about q. Thus $\beta_i(q_s|a=Q) = 1/S$ for all s. The strategies of the buyers are to bid 0 if any other announcement is made, regardless of their private valuations, and to bid the Bayesian equilibrium bidding strategies for the auction with their original priors on q and other buyers' valuations. This equilibrium bidding function is given by

$$b_i^*(\bar{v}_i|a=Q) = \frac{(S+1)}{2}q_1 + \bar{v}_i - \int_0^{\bar{v}_i} \left[\frac{F(t)}{F(\bar{v}_i)}\right]^{n-1} dt \qquad (1)$$

where $\bar{v}_i = \frac{1}{S}\sum_{k=1}^{S} v_i^k$ and $F(\cdot)$ is the distribution function of $\bar{v}_i$. The first term in (1) is the expected quality level, the second term is buyer i's expected private value and the third term is the expected difference between buyer i's valuation and the second highest private valuation conditional on buyer i having the highest private valuation.

At the other extreme is an equilibrium supported by beliefs which "assume the worst" when the seller announces $\bar{Q}$. At this equilibrium, the seller always announces q_j except possibly at j=1. When j=1, the seller is indifferent between announcing q_1 and announcing Q. Thus, $\beta_i(\cdot|a=Q)$ is degenerate at q_1. The equilibrium bidding function is given by:

$$b_i^*(v_i|a=q_j) = q_j + (v_i)(n-1)/n \qquad (2)$$

Between these two extremes, there are numerous other equilibria similar to the one where buyers are naively credulous. All of these share the property that the seller reveals the quality for certain quality levels, but for other levels, the seller makes a noninformative announcement. If the seller deviates from these equilibrium announcements, the buyers bid 0 for the seller's item. These equilibria all possess the undesirable property that buyers' bids off the equilibrium path are not rational. In particular, it is not sequentially rational for all buyers to bid 0 after the seller announces the true quality of the object.

All equilibria, except for the one where buyers assume the worst, are ruled out by the sequential equilibrium concept introduced by Kreps and Wilson [1982]. These equilibrium are ruled out since they are supported by behavior off the equilibrium path which is not sequentially rational. The argument of Grossman [1981], Milgrom [1981] and Milgrom and Roberts [1986] for why the only sequential equilibrium involves full disclosure (except possibly at the lowest quality level) goes as follows. If the seller announces Q, the buyer realizes that the seller's item must be of a quality level such that the price he receives by making an noninformative announcement when bidders use (1) is higher than the price he would receive by revealing the quality of his unit, when bidders use (2). With such reasoning, a buyer assigns zero probability to the item being of the highest quality when the seller's announcement is uninformative. With these conditional probabilities the amount that a buyer will bid in (1) is reduced, and buyers will use a bidding function in which $\bar{q}$ in (1) is replace by $\bar{q}' = \Sigma_{q_j < q_S} q_j/(S-1) = Sq_1/2 < \bar{q}$. Iteration of this argument produces an "unravelling" of the nondisclosure equilibrium and demonstrates that in a sequential equilibrium beliefs must "assume the worst". Therefore, the seller is indifferent between blind bidding or revealing the quality of the lowest quality unit, but strictly prefers to disclose all other qualities.

Summarizing, there are many Bayesian Nash equilibria to this two stage bidding game. However, applying standard sequential rationality arguments eliminates all but one of these equilibria--the "assume the worst" equilibrium.

II. Laboratory Markets

A. EXPERIMENTAL DESIGN

The results from six experimental markets are reported below. We examined the behavior in two different environments which differed in the way in which the buyers' valuations were determined. In the first environment, all items had common value components only; buyers did not have private values for the object. In the second environment, all items had both a common value and a private value component. Markets were run using undergraduate students at three different locations: Carnegie-Mellon University, the University of Arizona and the University of Iowa. Within each environment we conducted three markets; one at each of these locations.

There were eight participants in each market. After the participants arrived, four of them were randomly designated as buyers and the other four as sellers. The instructions, which are reproduced in Appendix 1, were read aloud and any questions were answered. Subjects were informed about the rules that would govern trade and how their earnings would be determined. Specifically, subjects were told that: 1) the highest bidder for an item would be awarded that item, 2) each buyer would receive a "resale value" for each item purchased and a buyer's profits from purchasing a unit was equal to his resale value minus the amount that he had bid, and 3) a seller's profits from selling a unit were equal to the amount the highest bidder had bid.

Each market consisted of a number of trading periods. In each period, each seller had one unit to offer for sale to the buyers. In the first environment we examined, all buyers had a common same resale value for an item although this value was generally different for different items. In each period and for each item, this common value (in cents) was drawn with replacement from the interval [1, 125] where all integers in this interval were equally likely. A sequence of random draws was preselected and this sequence was used in the markets conducted at all three locations.

At the beginning of each trading period, each seller was told the common resale value of the unit he had for sale in that period. The seller then decided whether to reveal this information to the buyers. After all sellers had made their decisions, they were publicly announced by the experimenter. If the seller chose to reveal his information, the resale value of his unit was publicly displayed to all market participants. Next, a first-price sealed bid auction was conducted for each seller's item. Each buyer submitted a separate bid for each item. After all bids had been submitted to the experimenter, both the winning bidder and his bid were publicly displayed. The losing bids were not publicly announced but all bids on a seller's item were given to that seller. Any ties were resolved using a random number table. Also, the common resale value of all units which the sellers had not revealed were publicly announced at the end of each period.

All buyers were endowed with $5.00 in "working capital" at the beginning of the experiment. This was to compensate for any loss which would result if the buyer were to bid in excess of his value and have his bid accepted. While no buyer in our markets ever lost money on items whose common resale values were revealed by sellers, such losses did arise on items which sellers chose to blind bid. Buyers were also paid 25 cents for each period that was conducted.

The procedures for the second environment we examined were identical to the first except that each buyer's valuation for a unit had both a common value and private value component. This change was made to increase the equilibrium

profits that buyers could earn. In the common value only auctions, the equilibrium bidding strategy for buyers requires that they bid the full value of a unit whenever the seller announces its quality (see (2)). Thus, an "assume the worst" equilibrium is one in which buyers earn zero profits.

In the second environment, a seller's item was one of eight possible "types" where an item's type determined its common value to the buyers. In each period, the type of each seller's item was randomly determined, where each possible type was equally likely. The previous sequence of resale values was rescaled to the interval [1, 120] and the resulting distribution was divided into eight disjoint subintervals, each of which had a length of 15 cents. Thus, a type I unit had a common value of 1 cent, a type II unit a common value of 16 cents, and type III unit's common value was 31 cents, and so forth. Use of this rescaling technique preserved the same pattern of high and low quality items as in the three markets of the first environment. Each buyer's private valuation was drawn from the interval [0,14] where all integers in this interval were equally likely. Thus, the range of possible resale values for buyers was [1,15] for a type I unit, [16, 30] for a type II unit, etc. Each buyer's valuation for each type of unit was determined by an independent draw from the corresponding range of possible resale values for that type. Within that range, each integer value was equally likely. Thus, given a unit's type, buyers generally had different resale values. However, observe that the private value uncertainty is quite small compared with the common value component. Among other things this means that the last term of the equilibrium bidding function in (1) is less than $.05. Nonetheless, this technique ensures that buyers earn strictly positive expected profits in the sequential equilibrium.

Each experimental market lasted between two and a half and three hours. At the end of the session, each participant was privately paid the amount of their earnings. In the discussion that follows in the next session, we will adopt the mnemonic "Sn" when referring to a particular market. The code S can take on one of three values which identify the site where the market was conducted: "A," "C," and "I" refer to the University of Arizona, Carnegie-Mellon University, and the University of Iowa, respectively. The code n will either be a "1" or a "2" to identify the environment which was used.

B. HYPOTHESES

In this section, we apply the predictions of section II to the environments and parameters we described above. We will examine only two of the Bayesian Nash equilibria -- the one in which buyers are naively credulous and the sequential equilibrium in which buyers assume the worst. After reviewing our results below, it will be apparent that there is no support for the other Bayesian Nash equilibria.

We begin by examining the predictions about which items will be blind bid. If buyers are naively credulous, sellers should blind bid all items in both environments. Formally this gives us

HYPOTHESIS 1: In all markets, $a=Q$ for all sellers in all periods.

Alternatively, if buyers assume the worst, sellers should reveal the quality of their object, except, perhaps, when they are endowed with a unit of the lowest quality level. Sellers should be indifferent about revealing the quality of these lowest quality units.

HYPOTHESIS 2: In all markets, $a=q_j$ for all $j>1$, for all sellers in all periods. Further $a\in(q_1,Q)$ if $j=1$.

There is also a question about how the sequential equilibrium is achieved. As Milgrom and Roberts [1986] point out, in order to reach the "assume the worst" equilibrium, every buyer must be sophisticated, that is, capable of game-theoretic reasoning. Realistically, it is unlikely that all buyers are this sophisticated. It is possible however, that unsophisticated buyers will not remain unsophisticated indefinitely -- especially in situations where they can each observe many replications of a market and can accumulate observations from the joint distribution of market data and state of nature. Over time, it seems reasonable to expect that unsophisticated traders will eventually understand that items of quality levels exceeding some particular quality level, say q_j, are never sold via a blind bidding auction while items which have quality levels less than or equal to q_j are always sold through blind bidding. In this way an unsophisticated buyer will gradually adopt conditional probability beliefs closer to a sophisticated buyer. Eventually, in equilibrium, q_j should converge to q_1, and all buyers will adjust their beliefs accordingly. Thus, we can imagine the sophisticated equilibrium being approached through this unravelling process. The next hypothesis captures this idea about the nature of convergence to a sequential equilibrium.

HYPOTHESIS 3: Let q_{min}^{t-1} be the minimum quality level which a seller has chosen to reveal in periods 1,...,t-1, and let q^t be the quality level which the seller is endowed with in period t. In all markets, the seller will not blind bid the item if $q^t \geq q^{t-1}_{min}$.

We next wish to examine the behavior of the selling prices in the auctions we conducted. We will not, however, concern ourselves with the prices for those items whose seller revealed its quality. The behavior in first price private value auctions has been examined extensively by Cox, Roberson and Smith [1982] and our data is consistent with their previous findings. In our second environment, our private value intervals are far too small to allow us to gain any further useful insights on bidding behavior. We will examine the price behavior of those items which were blind bid for further insights into how these markets equilibrated.

The unravelling process provides a qualitative prediction about how the bids on blind bid items should behave over time. Initially all buyers hold naively credulous beliefs, but over time each buyer lowers his expectations about the common value of a unit whenever a seller makes a noninformative announcement. While we cannot measure buyers' expectations directly, this adjustment story has obvious implications about buyers' bidding behavior on blind bid objects. Since this is a hypothesis about expectations of the common value of a blind bid item, we must adjust the bids in the markets A2, C2, and I2 to account for the private valuations. To do this, we assume that in blind bid auctions buyers initially bid according to (1) and these bids decline over time. While an exact calculation of (1) is impractical, a close approximation (within a few cents) is given by:

$$b^*_i(\bar{v}_i \mid a=Q) = \frac{(S+1)}{2S} q_S + 3\bar{v}_i/4 \qquad (1')$$

for markets 4-6.

HYPOTHESIS 4: Let b^i_{jt} be the amount bidder i bids in period t on an item j which is blind bid. In the common value markets, A1, C1 and I1, $b^i_{j1} = (S+1)q_1/2$ and $b^i_{jt} \geq b^i_{jt+1}$, with strict inequality for some t. In markets with private valuations, A2, C2 and I2, $b^i_{j1} = (S+1)q_1/2 + 3\bar{v}_i/4$ and $b^i_{jt} - 3\bar{v}^i/4 \geq b^i_{jt+1} - 3\bar{v}^i/4$ with strict inequality for some t.

The final two hypotheses address the distributional and efficiency effects of blind bidding. First, it is frequently alleged by exhibitors of motion pictures that the practice of blind bidding more often than not results in losses due to overbidding. In contrast, the theoretical model predicts that this should not happen in a sequential equilibrium. Specifically, the model predicts:

HYPOTHESIS 5: In all markets, a buyer never pays more than his resale value, $q+v_i$, on any blind-bid item.

Finally, we turn our attention to the allocative efficiency of these markets. This is of no concern in markets 1-3 where all objects were of common value to the buyers. As long as all items are sold (which they were), any allocation is efficient. In markets 4-6, allocative efficiency requires that the buyer with the highest private valuation acquires the item. So that we may control for the common value component of each item, we measure the efficiency of a market period $\sum v^j_{win}/\sum v^j_{max}$, where v^j_{win} is the private valuation of the winning bidder for item j and v^j_{max} is the maximum valuation among all buyers for the item j. The sums are taken over the four items which are available for sale in a period. Both the models we have examined predict that the allocation should be 100% efficient in these markets. This gives:

HYPOTHESIS 6: In markets A2, C2 and I2, the average efficiency in each period is 100%.

III. Results

The time series of transactions for blind bid items in all six of our markets are presented in Figures 1-6, respectively.[3] An "X" indicates the average common value of blind bid items within each period, while an "O" indicates the average of the winning bids on these items.[4] A complete set of the common values of all items which were available in each market is displayed in Appendix 2.

A casual examination of these figures reveals an apparent unravelling of both the prices paid for blind bid items and the quality levels of these items. In 5 of the 6 markets, the transaction price of blind bid items was at 15 cents or less in the final period. The lone exception is Market C1, where prices of blind bid items remained above 30 cents throughout the entire market. As will be discussed below, this is due to the bidding of a single buyer. This behavior seemed due in part to the fact that in environment 1 buyers were earning at most two cents profit on items whose quality was revealed. To overcome this possible incentive problem, we attempted to increase the profit opportunities for the buyers in environment 2 by incorporating private valuations.

[3]A complete set of data for these markets is given in Appendix 2.

[4]Particular care should be taken when examining the graphs from Markets A2, C2 and I2. The excess of the average winning bid over average common value is greater than the corresponding difference in the other three markets. This apparent discrepancy is due to the private valuations present in Markets A2, C2 and I2.

As the foregoing discussion about the unravelling in these markets suggests, Hypothesis 1, that all items are blind bid, fares very poorly. As can be seen from Table 1 as well as the figures, far less than half of the items were blind bid in all six markets. Thus, we reject Hypothesis 1.

We next examine Hypothesis 2 which states that buyers assume the worst and thus, sellers reveal the quality of all units except perhaps those of the lowest quality level. The data we used to test this hypothesis is also given in Table 1. For markets with private values (Markets A2, C2 and I2), this table gives all of the items which were blind bid which were not units of the lowest quality. Since buyers' valuations for the lowest quality units were in the interval [1,15], we also excluded units who were valued at fifteen cents or less in the markets without private values (Markets A1, C1 and I1). Using the data from <u>all</u> periods of each market, there is little support for Hypothesis 2. In the markets with private values, 12.3% of these items were blind bid; similarly, only 26.3% of all items in markets without private values.

On the other hand, it has been well-documented (see Plott [1982] and Smith [1982]) that experimental markets do not attain an equilibrium instantaneously; instead, they tend to converge. While there is no established convention for deciding how to test equilibrium predictions on experimental data, we have chosen to examine our data after ten periods have occurred. From the bottom two rows of Table 1, it can be seen that the sequential equilibrium prediction given in Hypothesis 2 performs quite well after period 10 in five of the six markets. In three of these markets, A1, A2, and C2, items with common values in excess of 15 cents were never blind bid after period ten. In two of the markets, I1 and I2, only three items were blind bid after period ten; in I1 these three units had a common value of 28 cents or less and each of the three units in I2 were of the second lowest quality level (i.e. had a common value of 16 cents). The only market where Hypothesis 2 is not supported is C2, where 29.2% of all units (14 of 48) were blind bid after period ten although 12 of these items were awarded to one bidder who continued to bid in excess of 30 cents for these items. Consequently, items which had common values of this amount or lower were still being blind bid at the conclusion of the auction. Nonetheless, the amount being bid for blind-bid items as well as the average common value of these items were still declining at the conclusion of the auction. Thus, we do not believe that this market is strong evidence against Hypothesis 2; instead, we would argue that while the market has not fully unravelled, the unravelling process was continuing (albeit slowly) when the market was terminated.

As a separate point, recall that the sequential equilibrium model also predicts that sellers should be indifferent between blind bidding and revealing the quality of the lowest quality units. If such were the case, we should see approximately an equal amount of revelation and blind bidding on these low quality units. Such is not the case, however. Sellers blind bid 27 out of 28 type 1 units in environment 2 and 19 out of 19 units with a common value of 15 cents or less in environment 1. Sellers apparently feel they have nothing to lose by not revealing a low quality unit as long as they believe there is a positive probability (perhaps very small) that some buyer will overbid on that unit.

Since our results indicate that our markets are indeed approaching the sequential equilibrium, we next examine Hypothesis 3 about how an equilibrium

is achieved in these markets. This hypothesis states that once a seller reveals the quality of a particular item, items of higher quality are never blind bid by <u>any</u> seller in the market. In Table 2, we present a list of observations where this hypothesis fails. As can be seen, it never fails in markets A1, I1, C2 and I2 and it fails only once in market A2. This latter failure occurs in a very early market period (period 2). This hypothesis fails four times in market C1, but the same seller is responsible for all of the contradictory observations. Thus, there is substantial evidence in support of the unravelling hypothesis.

We next test the implications of the unravelling hypothesis on buyers' bidding behavior as stated in Hypothesis 4. Recall that this hypothesis has two parts. The first part, which is concerned with the bidding on blind bid items in the first period of each market, postulates that buyers are initially naively credulous and that they will bid according to (1′). To test this hypothesis we compute the difference between each bid on a blind bid item in period 1 and the predicted bid as given by (1′). We next constructed three pooled data sets. Two data sets consisted of the pooled data across all markets in the same environment and the third set consisted of the pooled data across both environments. We conducted t-tests to test the null hypothesis that this difference was zero and, regardless of which pooled data set was used, we are able to reject this hypothesis at the .0001 level. A further examination of the data indicates that buyers bid significantly less than predicted in the first period. Thus, while they haven't as yet begun to assume the worst, they are more skeptical than naively credulous.

The second part of Hypothesis 4 states that buyers' bids should decline monotonically over time as they lower their expectations about the common value of units which are blind bid. To test this hypothesis, we conducted several regressions to measure the time trend of prices and bids. In Table 3, the results using price as the dependent variable are displayed. In all six markets, the null hypothesis that the time trend is zero can be rejected at the .002 level or less when tested against the one-sided alternative that the time trend is negative. Thus, winning bids do decline monotonically over time.

We next tested the individual buyers' bidding behavior to see if it exhibited the same monotonicity. Our results are presented in Table 4A for the markets in environment 1 and in Table 4B for the environment 2 markets. An examination of these tables reveals two distinct kinds of bidding behavior. Most of the buyers (79% = 19/24) make bids which decline over time. In eighteen of these nineteen cases, the regression coefficient is significant at the .05 level.

The second type of bidding behavior is exhibited by a minority (21% = 5/24) who begin with very skeptical beliefs and discover that these beliefs are not justified initially since sellers are blind bidding higher quality levels than they had expected. These buyers then increase their bids, at least for a while, as they adjust their expectations about the common value of blind bid items. As the tables indicate, these buyers also tend to be the winning bidder on very few blind bid items since they are more skeptical than others in their market. These individuals are characterized by a bidding equation with a "small" intercept and a positive slope in Tables 4A and 4B.

There is one remaining buyer whose behavior is not classifiable under either of the two types described above. This is buyer 4 in Market C1, whose bidding behavior exhibits a negative time trend although it is not significantly different than zero. This individual received 69% of all blind

bid items and seems to have impeded the market from unravelling below the $.30 level.

We next turn our attention to Hypothesis 5 which state that buyers should earn non-negative profits on all blind bid items. The percentage of those items on which buyers paid more than their resale values are given in Table 5. These percentages all exceed 40% and, in one case (Market A1) exceeds 90%. Buyers are indeed incurring losses on a large proportion of the items which are blind bid.

However, while buyers' average profits on blind-bid items in each auction are negative, the null hypothesis that buyers earn non-negative average profits can only be rejected for Market A1 (and perhaps marginally so for Market C2). As the range of profits on blind-bid items given in Table 5 indicates, buyers' frequent losses on blind-bid items are almost offset by occasional large positive profits on other blind-bid items. Thus, the standard error of buyers' profits was sufficiently large to render the negative average profits as insignificant in most cases. It also follows that since buyers did not incur significant losses, the sellers also did not gain from blind bidding items. These results suggest that the institution of blind bidding does not lead to significant profit gains for either buyers or sellers but, instead, it increases the volatility of everyone's profits.

Finally we examine Hypothesis 6. The efficiency in each period for each market is given in Table 6, both using all items and excluding blind bid items. As can be seen from the table, all markets were operating at or near 100% efficiency during the last several periods prior to their conclusion. These efficient allocations were due largely to the sequential equilibrium being realized. The majority of misallocations occurred when units were blind bid even though less than 25% of all items were blind bid. The bottom two rows of the table show the number of units that were misallocated for units which were blind bid and for units whose quality was revealed. Of the 57 units which were blind bid, 37 of them (64.9%) were misallocated. When sellers revealed the quality of their units, only 14.4% (27 out of 187) of these units were misallocated. Thus, blind bidding decreases the allocative efficiency in these markets.

IV. Concluding Remarks

It is clear that the sequential equilibrium model is a good predictor of behavior in these simple markets. The importance of replication and learning is also very important in these markets. The sequential equilibrium is not instantaneously attained but there is an unravelling process which describes how this equilibrium is approached. A majority of buyers do not initially assume the worst, but they lower their expectations about the common value of a unit after observing the quality of each unit a seller chooses to blind bid. As the markets unravel toward the sequential equilibrium, buyers incur losses on a large proportion of those items which are blind bid. However, buyers' do not incur significant losses on average since they also make large profits on a number of blind-bid items. Finally, allocations tend to be fully efficient, ex post, at the conclusion of each market. Even in early periods, most of the ex post inefficiencies which were observed could be attributed to blind bidding.

In auctions for unique items, like the ones we have conducted, a sequential equilibrium will be attained if and only if <u>all</u> buyers adopt skeptical, assume-the-worst beliefs. If a single buyer is slow in adopting

this posture, the unravelling process by which a sequential equilibrium is attained can be seriously impeded. We have demonstrated one instance (Market C1) in which the unravelling was not complete due to the presence of such a buyer. In all other markets, the unravelling was complete, in spite of the fact that this equilibrium is not robust when there is a single deviant buyer.

To the extent that we have captured the salient features of the market for motion picture distribution rights, the practice of blind bidding seems to cause no difficulties once an equilibrium is obtained. After sufficient market experience, sellers only blind bid low quality items and buyers' bids indicated that they had adjusted their beliefs properly. Thus, if there is a case to be made against the practice of blind bidding from the evidence assembled here, it must be based on an analysis of unsatisfactory market performance while prices and beliefs are unravelling. During this disequilibrium phase, the practice of blind bidding results in an increased volatility of both buyers' and sellers' profits and allocations which are ex post inefficient.

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Figure 1: Common Values and Winning Bids for Blind Bid Items in Market A1

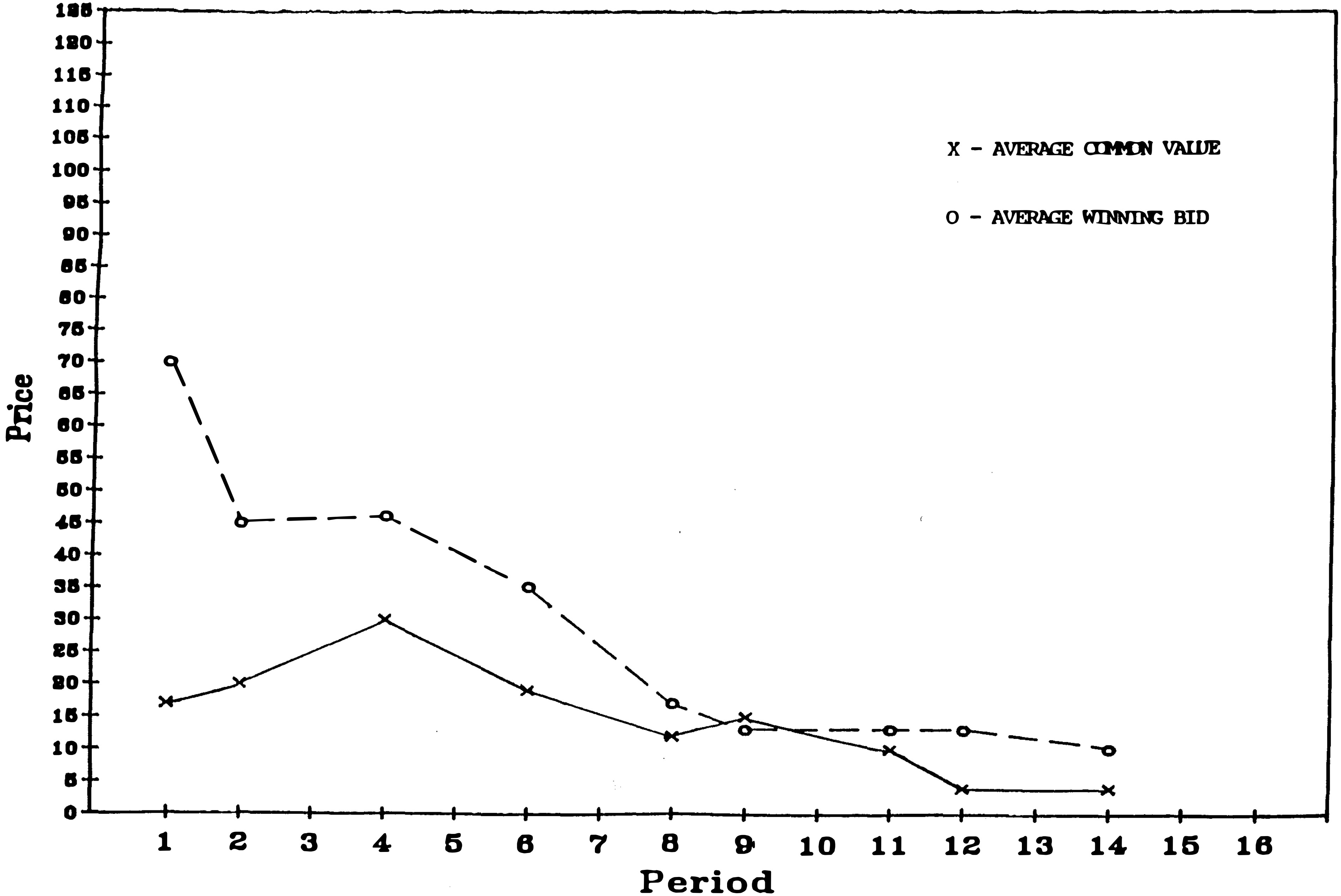


Figure 2: Common Values and Winning Bids for Blind Bid Items in Market C1

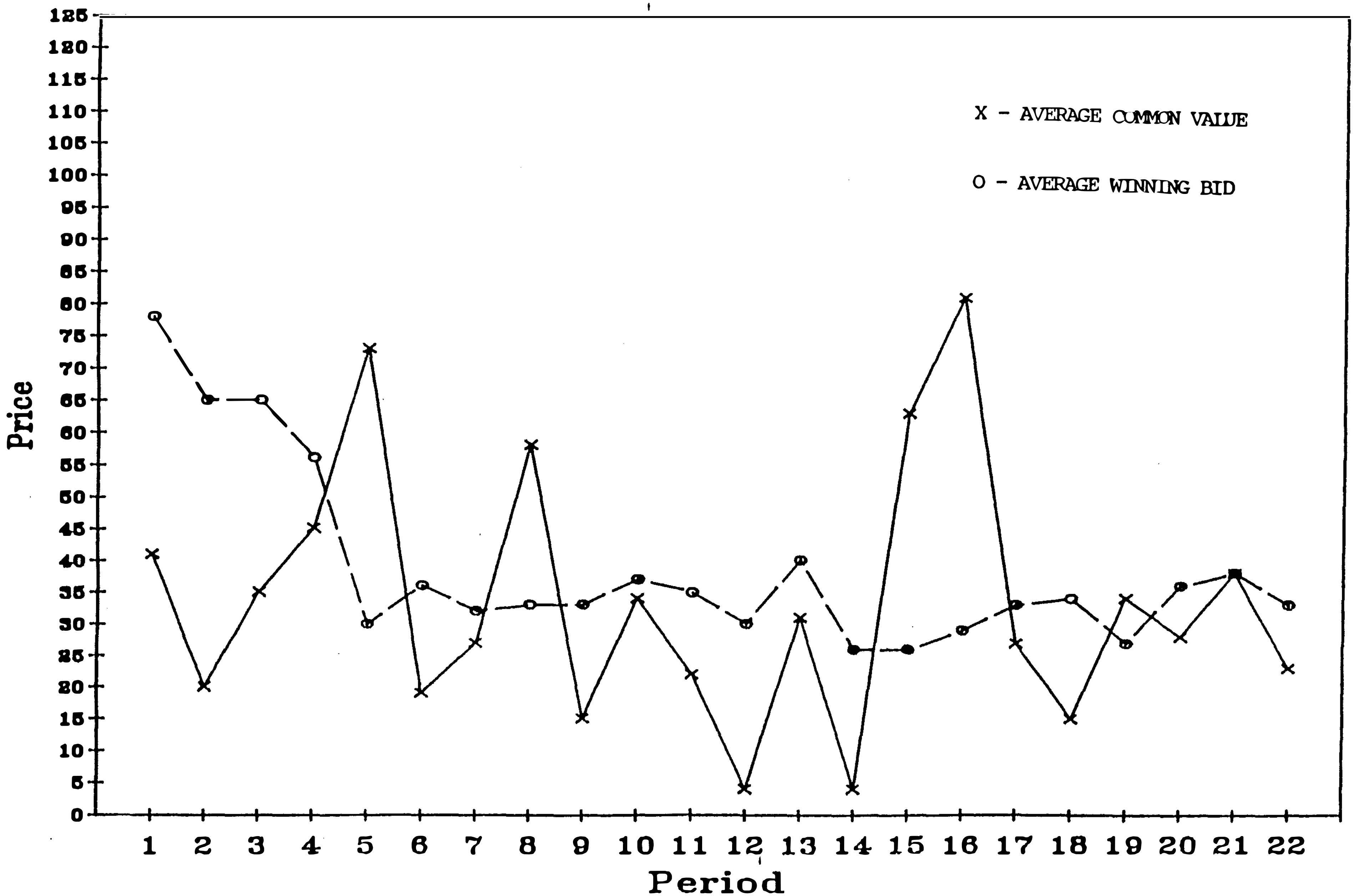


Figure 3: Common Values and Winning Bids for Blind Bid Items in Market I1

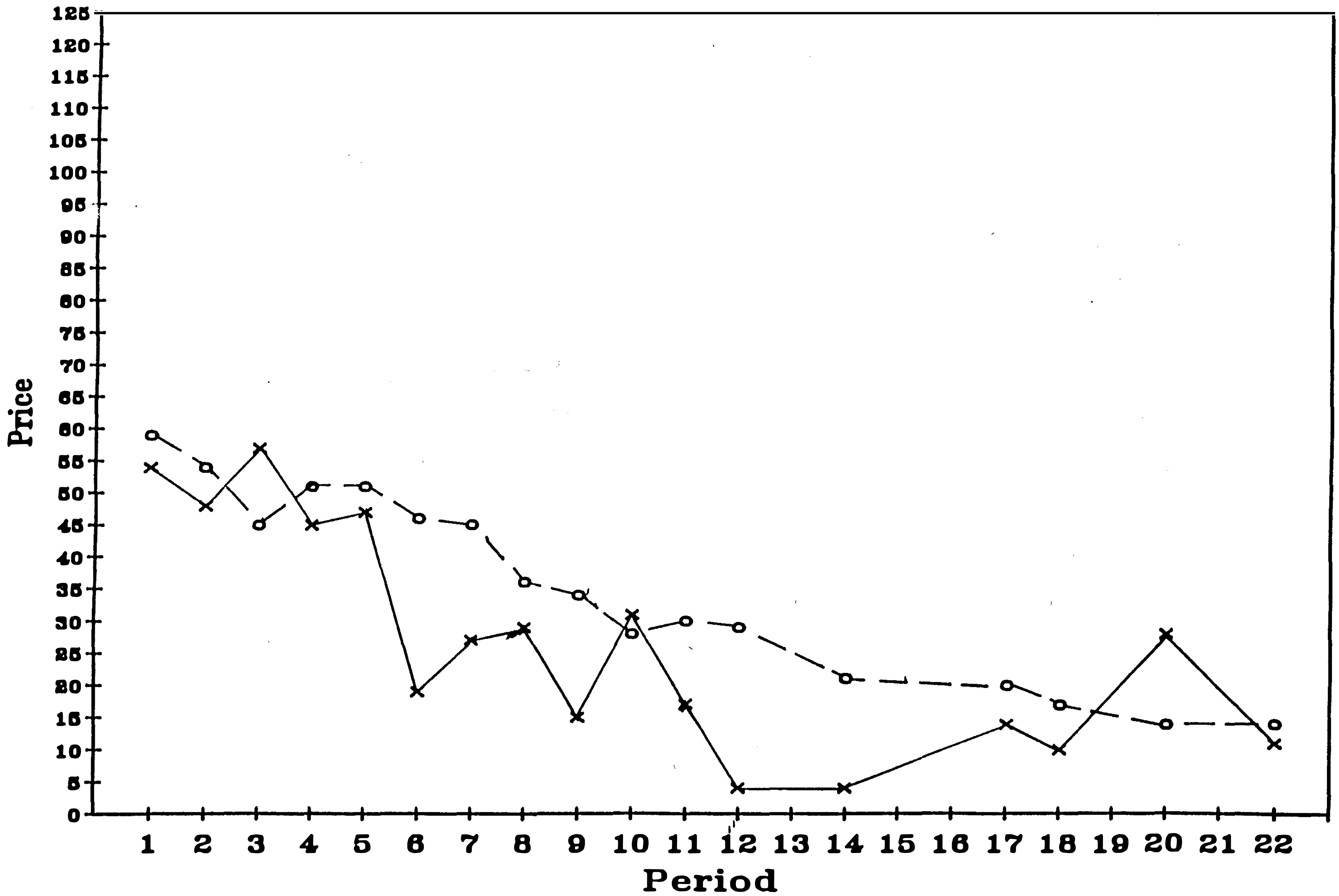


Figure 4: Common Values and Winning Bids for Blind Bid Items in Market A2

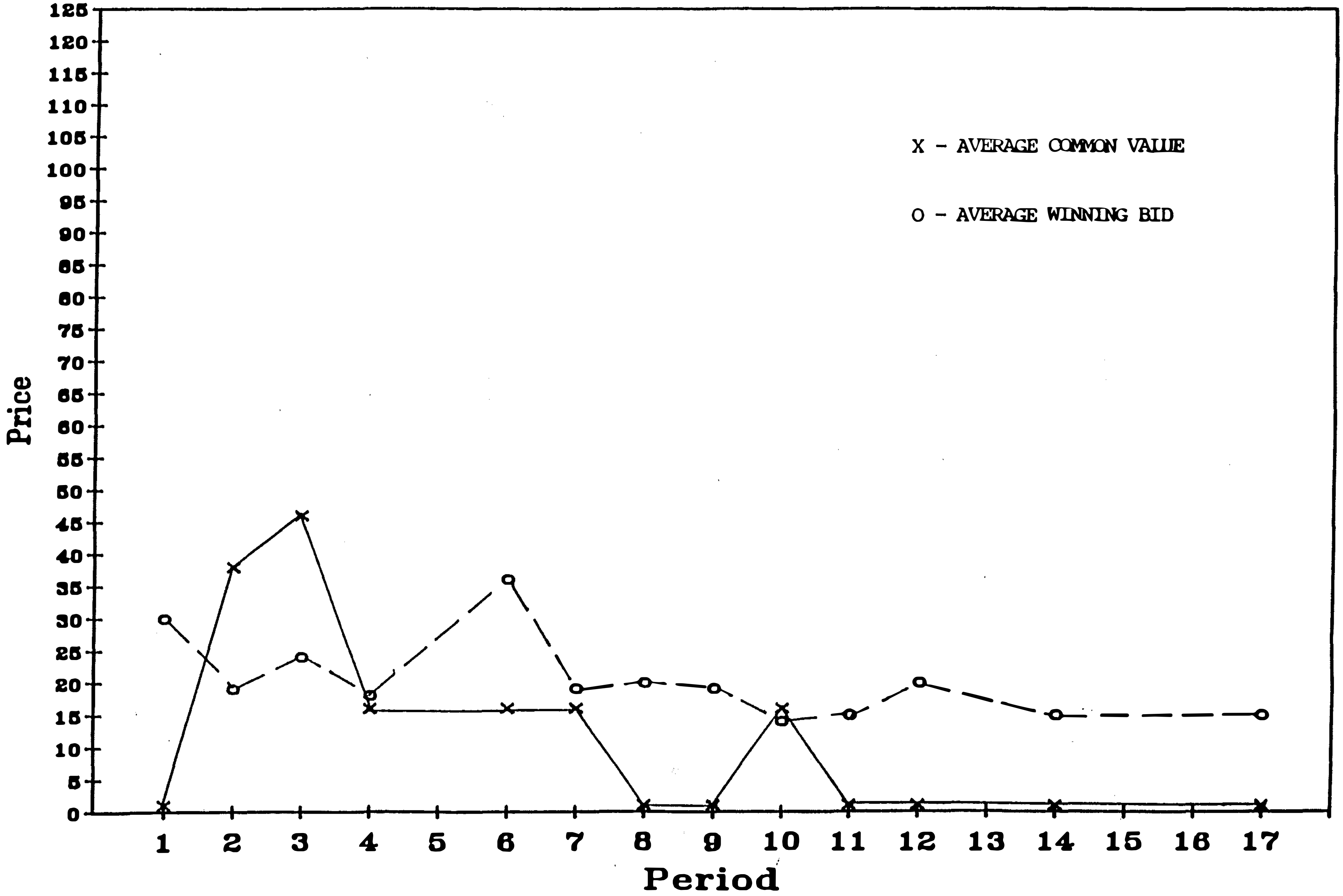


Figure 5: Common Values and Winning Bids for Blind Bid Items in Market C2

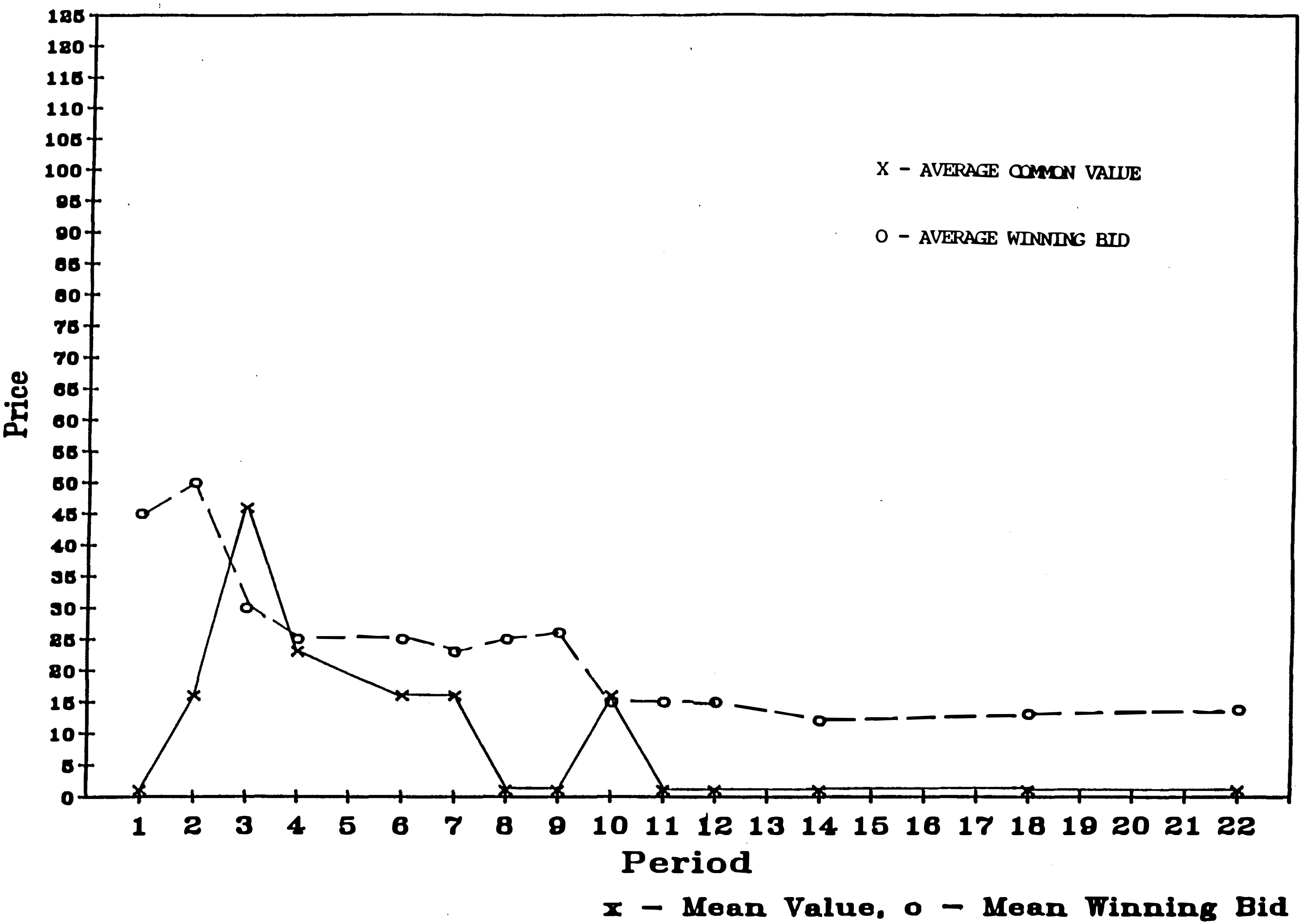


Figure 6: Common Values and Winning Bids for Blind Bid Items in Market I2

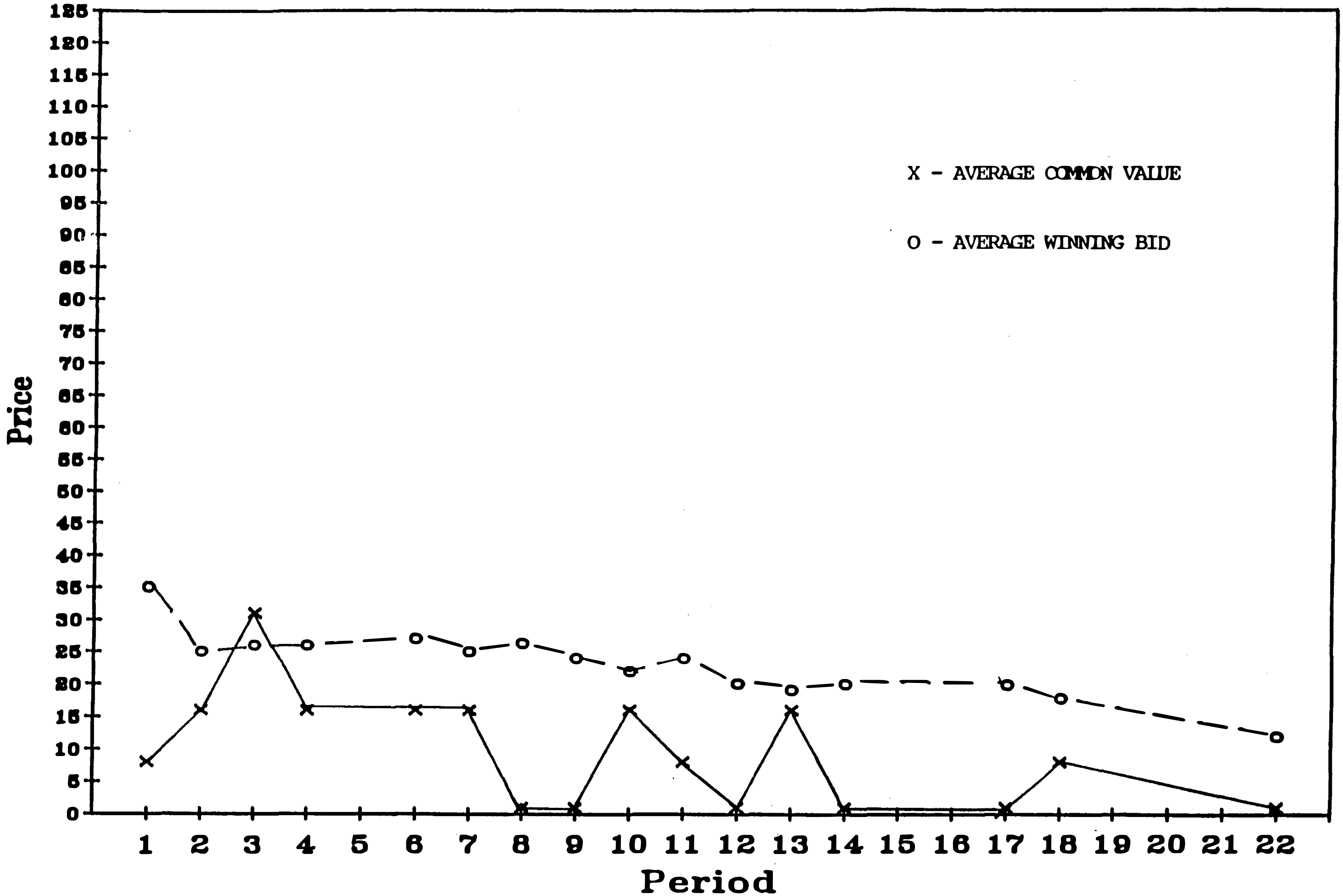


TABLE 1

ANALYSIS OF BLIND-BID ITEMS

An entry in this table gives the number of items which were blind bid in the corresponding period and market. The number in parentheses indicates the number of blind-bid items whose common value exceeded 15 (environment 1) or whose type was greater than 1 (environment 2).

	ENVIRONMENT 1			ENVIRONMENT 2		
PERIOD	A1	C1	I1	A2	C2	I2
1	2 (2)	3 (3)	4 (4)	1 (0)	1 (0)	2 (1)
2	1 (1)	1 (1)	2 (2)	2 (2)	1 (1)	1 (1)
3	0 (0)	1 (1)	2 (2)	1 (1)	1 (1)	1 (1)
4	1 (1)	3 (3)	3 (3)	1 (1)	2 (2)	1 (1)
5	0 (0)	2 (2)	1 (1)	0 (0)	0 (0)	0 (0)
6	3 (3)	3 (3)	3 (3)	3 (3)	1 (1)	3 (3)
7	0 (0)	2 (2)	2 (2)	2 (2)	1 (1)	2 (2)
8	1 (0)	3 (2)	2 (1)	1 (0)	1 (0)	1 (0)
9	1 (0)	2 (1)	2 (1)	2 (0)	2 (0)	2 (0)
10	0 (0)	2 (2)	1 (1)	1 (1)	1 (1)	1 (1)
11	1 (0)	3 (2)	2 (1)	1 (0)	1 (0)	2 (1)
12	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
13	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)
14	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
15	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
16	0 (0)	2 (2)	0 (0)	0 (0)	0 (0)	0 (0)
17		2 (1)	1 (0)	1 (0)	0 (0)	1 (0)
18		3 (2)	2 (1)		1 (0)	2 (1)
19		2 (2)	0 (0)		0 (0)	0 (0)
20		1 (1)	1 (1)		0 (0)	0 (0)
21		1 (1)	0 (0)		0 (0)	0 (0)
22		2 (1)	1 (0)		1 (0)	1 (0)
% of items blindbid	18.8% (10.9%)	47.7% (38.6%)	35.2% (26.1%)	26.5% (14.7%)	18.2% (8.0%)	26.1% (14.8%)
Average by environment		35.4% (26.7%)			23.4% (12.3%)	
% of items blindbid excluding first 10 periods	12.5% (0.0%)	41.7% (29.2%)	18.8% (6.3%)	14.3% (0.0%)	10.4% (0.0%)	18.8% (6.3%)
Average by environment		26.7% (14.2%)			14.6% (2.4%)	

TABLE 2

CONTRADICTORY OBSERVATIONS TO THE UNRAVELLING HYPOTHESIS

Market	Period	Seller	Lowest Common Value Previously Revealed	Common Value of Item Blind Bid This Period
A1	NONE			
C1	5	4	76	99
	8	4	76	118
	15	4	45	63
	16	4	45	116
I1	NONE			
A2	2	4	31	61
C2	NONE			
I2	NONE			

TABLE 3

ESTIMATION OF EQUATION $P_t = \alpha_1 + \Gamma_1 t + \mu_t$

Market	N	α_1	Γ_1	P-value*
A1	12	64.76 (4.69)	-4.66 (.60)	0.000
C1	42	55.48 (3.61)	-1.48 (.29)	0.000
I1	31	58.65 (1.72)	-2.35 (.17)	0.000
A2**	17	22.42 (1.94)	-.52 (.22)	0.018
C2	16	36.94 (3.23)	-1.47 (.31)	0.000
I2	23	31.75 (1.09)	-.82 (.10)	0.000

* These P-values are the critical probabilities for testing the hypothesis, H_0: $\Gamma_1=0$, against the <u>one</u>-sided alternative, H_1: $\Gamma_1<0$.

**We dropped one observation from our analysis of this market due to a discrepancy in the data. This occurred in period 6, where we awarded seller 4's item to buyer 4 at a price of $.79. While this buyer's bidding form confirms this action, he recorded that he had bid $.79 for seller 3's item and only $.05 for seller 4's item.

Standard error of the estimate is given in parentheses.

TABLE 4A

ESTIMATION OF EQUATION $b_t = \alpha_2 + \Gamma_2 t + \mu_t$

ENVIRONMENT 1

Market	Buyer	α_2	Γ_2	P-value*	Items Won
A1	1	45.32 (4.81)	-2.81 (.61)	0.001	6
	2	25.95 (5.61)	-1.58 (.72)	0.025	2
N=12	3	44.06 (10.11)	-3.39 (1.29)	0.013	3
	4	39.81 (4.53)	-3.08 (.58)	0.001	1
C1	1	26.00 (6.01)	-1.61 (.48)	0.001	7
	2	16.42 (1.66)	.45 (.13)	0.999	3
N=42	3	41.88 (3.01)	-.98 (.24)	0.000	3
	4	33.53 (3.54)	-.04 (.28)	0.497	29
I1	1	35.05 (3.51)	-1.02 (.35)	0.003	8
	2	31.14 (3.29)	-.57 (.33)	0.047	9
N=31	3	26.22 (3.31)	-1.17 (.33)	0.001	0
	4	53.57 (2.80)	-2.46 (.28)	0.000	14

* These P-values are the critical probabilities for testing the hypothesis, H_0: $\Gamma_2=0$, against the <u>one</u>-sided alternative, H_1: $\Gamma_2<0$.

Standard error of the estimate is given in parentheses.

TABLE 4B

ESTIMATION OF EQUATION $b_t = \alpha_e + \Gamma_e t + \mu_t$

ENVIRONMENT 2

Market	Buyer	α_e	Γ_e	P-value*	Items Won
A2	1	6.44 (1.77)	.78 (.21)	0.999	5
	2	8.33 (1.97)	.11 (.23)	0.683	1
N=18	3	25.29 (2.06)	-1.17 (.24)	0.000	10
	4**	6.75 (2.31)	.31 (.27)	0.666	2
C2	1	24.14 (4.21)	-.86 (.41)	0.026	4
	2	22.05 (4.70)	-1.09 (.45)	0.015	0
N=16	3	32.05 (2.20)	-1.38 (.21)	0.000	9
	4	22.12 (5.17)	-.89 (.50)	0.048	3
I2	1	8.59 (2.33)	.55 (.21)	0.991	6
	2	14.94 (2.48)	-.51 (.23)	0.019	0
N=23	3	26.96 (3.19)	-.78 (.29)	0.007	7
	4	28.82 (1.73)	-.89 (.16)	0.000	10

* These P-values are the critical probabilities for testing the hypothesis, H_0: Γ_e=0, against the <u>one</u>-sided alternative, H_1: Γ_e<0.

**For buyer 4 in market A2, we used only 17 observations for the reasons given in Table 3.

Standard error of the estimate is given in parentheses.

TABLE 5

BUYERS' PROFITS ON BLIND-BID ITEMS

Market	No. of Blindbid Items	% of Unprofitable Purchases	-----Buyers' Profits----- Range	Average	P-value*
A1	12	91.7	[-54, 2]	-18.17	.003
C1	42	66.7	[-73,84]	- 4.76	.262
I1	31	67.7	[-57,41]	- 4.83	.224
A2	18	44.4	[-51,51]	- 0.17	.487
C2	16	50.0	[-43,27]	- 5.56	.098
I2	23	43.5	[-26,14]	- 4.91	.210

* These P-values are the critical probabilities for testing the null hypothesis that buyers' average profits are non-negative.

TABLE 6

EFFICIENCIES IN ENVIRONMENT 2

Efficiency is computed as the sum of the private values of the bidders who were awarded each of the four items divided by the sum of the highest private values, for the four items. The percentages in parentheses indicate the efficiency when blind bid items are excluded from the data.

PERIOD	A2	C2	I2
1	.93 (.91)	.65 (.88)	.91 (1.00)
2	.66 (.67)	.74 (.78)	.90 (1.00)
3	.97 (1.00)	.96 (.97)	.90 (.97)
4	.80 (.97)	.65 (1.00)	1.00 (1.00)
5	1.00 (1.00)	.95 (.95)	.98 (.98)
6	1.00 (1.00)	1.00 (1.00)	1.00 (1.00)
7	.78 (1.00)	.88 (1.00)	1.00 (1.00)
8	.62 (.86)	.72 (1.00)	.70 (.97)
9	.90 (1.00)	.90 (1.00)	.90 (1.00)
10	.70 (.93)	.75 (.93)	.95 (.93)
11	.77 (.75)	.98 (.97)	.75 (.96)
12	.98 (1.00)	.90 (.89)	.81 (.89)
13	.96 (.96)	1.00 (1.00)	.96 (1.00)
14	.74 (1.00)	1.00 (1.00)	.74 (1.00)
15	1.00 (1.00)	1.00 (1.00)	1.00 (1.00)
16	1.00 (1.00)	1.00 (1.00)	1.00 (1.00)
17	1.00 (1.00)	1.00 (1.00)	.86 (1.00)
18		1.00 (1.00)	.78 (1.00)
19		1.00 (1.00)	1.00 (1.00)
20		1.00 (1.00)	1.00 (1.00)
21		1.00 (1.00)	1.00 (1.00)
22		1.00 (1.00)	1.00 (1.00)
Avg. Eff. per Period	.87 (.94)	.91 (.97)	.92 (.99)
Number of Misallocated Units	21 (8)	22 (11)	21 (8)
% of Units Misallocated Under Blind Bidding	13/18 72.2%	11/16 68.8%	13/23 56.5%
% of Units Misallocated When Quality Revealed	8/50 16.0%	11/72 15.3%	8/65 12.3%

APPENDIX 1

In what follows, the titles in parentheses were not in the instructions which subjects received. They have been inserted so that we may conveniently illustrate how the two instruction sets we used differed.

INSTRUCTIONS

I. GENERAL. This is an experiment in the economics of market decision-making. Various research foundations have provided funds for this research. The instructions are simple, and if you follow them carefully and make good decisions you might earn a considerable amount of money which will be paid to you in cash at the end of the experiment.

In this experiment, we are going to conduct a market in which some of you will be buyers and some of you will be sellers in a sequence of trading periods. Your identification is at the top of this page. It tells you whether you are a buyer or a seller. There are a total of 4 sellers and 4 buyers in the market.

II. SPECIFIC INSTRUCTIONS TO SELLERS. (IIA. MARKET INSTRUCTIONS FOR SELLERS.) At the beginning of each trading period you will be given one item to sell. Each buyer has the opportunity to enter a bid for your unit. You will receive a bidding form from each buyer which will indicate the amount that he/she is willing to pay for your unit. You must sell your item to the bidder who submits the highest bid and you will receive the amount that he/she bid.

The amount which a buyer will earn if he/she purchases your unit is given by your unit's "resale value." This resale value is the amount at which the winning bidder can resell the item to the experimenter. All bidders will have the same resale value for your item in a given trading period. However, this common resale value will not in general be the same for each of the seller's units in a given trading period and it will not in general be the same from period to period.

In your folder you have been given a number of sealed envelopes which have your seller number and a trading period number on them. At the beginning of each trading period, you will open the envelope which corresponds to that period. Each envelope contains a slip of paper on which the buyers' resale value for your unit in that trading period has been written. Before buyers submit bids for your unit, you must come to a decision about whether or not you wish to allow the buyers to see their resale value. If you agree to reveal your resale value before bidding starts, it will be publicly displayed to all market participants.

(IIB. COMPUTING A SELLER'S PROFITS.) At the end of each trading period, record the amount you received for your unit on your profit sheet. At the end of the experiment, add up the amounts you have earned in each trading period on your profit sheet. The experimenter will pay you this amount in cash.

III. SPECIFIC INSTRUCTIONS TO BUYERS. (IIIB. MARKET INSTRUCTIONS FOR BUYERS.) Remember that the amount you will earn if you purchase a unit is given by that unit's resale value. Each seller knows your resale value for the item he/she has for sale. At the beginning of each trading period you can enter bids on each seller's item. Before doing so, you will see whether or not each seller announces the resale value for the item he wishes to sell. These values, which are in the envelopes each seller has been given, have been determined as follows: In each period and for each seller's item, the resale value has been chosen by random drawing. Each resale value between $.01 and $1.25 in increments of 1 cent had an equally likely chance of being chosen in the drawing. Remember, a different drawing was held for each seller's item and each period. Every time a drawing occurred, the numbers (resale values)

$.01, $.02, $.03, ..., $1.23, $1.24, $1.25

each had an equally likely probability of 1/125 of being chosen. The resale value of one item has no effect on the resale value of any other item.

In your folder, you will find an ample supply of bidding forms. After you have found out whether or not each seller announces the resale value for his unit, you should fill out a bidding form for each seller's unit. On this form, write the trading period number, your buyer number, the number of the seller to whom you are sending this form, and the amount you bid for that seller's unit. If you do not wish to bid for a particular seller's unit, enter a bid of zero on the form you send to that seller. This will guarantee that you do not purchase that unit. Remember that the seller's unit will be awarded to the buyer who makes the highest bid and that buyer must pay the seller the amount he/she bid. If two or more buyers submit the same highest bid, we will resolve this tie by a random choice of buyer. At the end of each trading period, we will announce: (1) the resale value of each unit, (2) which bidder purchased which seller's unit, (3) the amount of the bid each winning bidder submitted. At that time you will be able to see the resale values for all units, including those which were not previously announced by the sellers.

(IIIB. COMPUTING A BUYER'S PROFITS.) In each trading period, your earnings are composed of two parts: base earnings and trading profits. Your base earnings are $.25 in each trading period. Your trading profits are computed as follows: For each unit that you purchase, your trading profits on the purchase of that unit are given by the difference between the resale value of the item purchased and the amount you bid for that unit. That is,

TRADING PROFITS FROM BUYING ONE UNIT = RESALE VALUE - AMOUNT BID.

The total earnings to each bidder are determined as follows:

A Losing bidder earns $.25 in base earnings for that period.

A Winning bidder earns $.25 (just like a losing bidder) plus the earnings from all units purchased.

You have been given a number of BUYER'S RECORD SHEETS. Each record sheet corresponds to a trading period number. When you learn the resale value of a seller's item, record that amount on line 1, corresponding to that seller's identification. When you make a bid on a seller's item, record your bid on line 2, corresponding to that seller's identification. For those units for which you are the winning bidder, subtract line 2 from line 1 and record the difference on line 3. This is your trading profits from buying one unit. At the end of the trading period, add your trading profits from all units

purchased and record this total on line A. Add your base earnings (line B) to this amount and record this total on line C. This is your earnings for the trading period.

You should keep a cumulative total of the amount you have earned during the experiment by adding the amount you earned this period on line C to the total amount you earned through the end of the previous period (line D). Record this total on line E. This is your total earnings at the end of this period. At the end of the experiment, this will be the total earnings for the experiment. The experiments will pay you this amount in cash.

It is possible that a buyer might lose money on the purchase of a particular unit in a particular trading period. This can happen if the buyer wins a unit at a price (his or her bid) which is greater than the resale value for that unit. Because of the possibility of losses, we begin the experiment by giving each buyer 5 dollars. This amount is recorded on line D of your record sheet for trading period 1.

(In the second instruction set, section IIA. and IIIA. were replaced by the following.)

(IIA. MARKET INSTRUCTIONS FOR SELLERS.) At the beginning of each trading period you will be given one item to sell. Each buyer has the opportunity to enter a bid for your unit. You will receive a bidding form from each buyer which will indicate the amount that he/she is willing to pay for your unit. You must sell your item to the bidder who submits the highest bid and you will receive the amount that he/she bid.

The amount which a buyer will earn if he/she purchases your unit is given by your unit's "resale value." This resale value is the amount at which the winning bidder can resell the item to the experimenter. All bidders will generally have different resale values for your item in a given trading period. Further, these resale values will not in general be the same from period to period.

In your folder you have been given a number of sealed envelopes which have your seller number and a trading period number on them. At the beginning of each trading period, you will open the envelope which corresponds to that period. Each envelope contains a slip of paper on which the type of your unit in that trading period has been written. There are eight possible types of units. These are labelled I, II, III, IV, V, VI, VII, VIII. The type of a unit determines the range of resale values of the buyers for that unit. The following table gives the range of the resale values for each type of unit:

Type of Unit	Range of Resale Values
I	$ .01 - $ .15
II	$ .16 - $ .30
III	$ .31 - $ .45
IV	$ .46 - $ .60
V	$ .61 - $ .75
VI	$ .76 - $ .90
VII	$ .91 - $1.05
VIII	$1.06 - $1.20

Before buyers submit bids for your unit, you must come to a decision about whether or not you wish to allow the buyers to see your unit's type for that period. If you agree to reveal your unit's type before bidding starts, it will be publicly displayed to all market participants.

(IIB. MARKET INSTRUCTIONS FOR BUYERS.) Remember that the amount you will earn if you purchase a unit is given your private resale value for that unit. Each seller knows the type of the item he/she has for sale. At the beginning of each trading period you enter bids on each seller's item. Before doing so, you will see whether or not each seller announces the type of the item he wishes to sell. These types, which are in the envelopes each seller has been given, have been determined as follows: In each period the type of unit each seller has been given was determined by random drawing. Each type between I and VIII had an equally likely chance of being chosen in the drawing. Remember, a different drawing was held for each seller's item and each period. Every time a drawing occurred, the numbers (types)

I, II, III, IV, V, VI, VII, VIII

each had an equally likely probability of 1/8 of being chosen. The type of one item chosen has no effect on the type of any other item.

As discussed above, the type of the unit determines the range of the resale values you may receive for that unit. In each period, each buyer's resale value for each type of unit was chosen by a separate random drawing. Given the type of unit, each value in the range of resale values had an equally likely chance of being chosen. For example, consider type IV units. In each period and for each buyer, a separate drawing occurred for that type. In each drawing the numbers (resale values)

$ .46, $ .47, $ .48, . . ., $ .58, $ .59, $ .60

each had an equally likely chance of being chosen. Similarly, consider type VII units. In each period and for each buyer, a separate drawing occurred for this type. In each of these drawings, the numbers (resale values)

$ .91, $ .92, $ .93, . . ., $1.03, $1.04, $1.05

each had an equally likely chance of being chosen. Remember, in each period different buyers generally have different resale values for each type of unit.

In your folder, you will find a sheet labelled YOUR RESALE VALUES. The columns on this sheet correspond to the type of unit and the rows correspond to the trading period number. This tells you your resale value for any unit that you may purchase during the experiment. In a given period, there may be more than one unit of the same type for sale. If you buy more than one unit of the same type in the same trading period, you will receive your resale value for that type for each unit that you purchase.

In your folder, you will also find an ample supply of bidding forms. After you have found out whether or not each seller announces the type of his unit, you should fill out a bidding form for each seller's unit. On this form, write the trading period number, your buyer number, the number of the seller to whom you are sending this form, and the amount you bid for that seller's unit. If you do not wish to bid for a particular seller's unit, enter a bid of zero on the form you send to that seller. This will guarantee that you do not purchase that unit. Remember that the seller's unit will be awarded to the buyer who makes the highest bid and that buyer must pay the seller the amount he/she bid. If two or more buyers submit the same highest bid, we will resolve this tie by a random choice of buyer. At the end of each trading period, we will announce: (1) the type of each unit, (2) which bidder purchased which seller's unit, (3) the amount of the bid each winning bidder submitted. At that time you will be able to see the types of all units, including those which were not previously announced by the sellers.

BUYER'S RECORD SHEET

Trading Period ______

1	1.* Type of Unit		
	2. Resale Value		
	3. Amount Bid		
	4. Trading Profits (if you are the winning bidder subtract line 3 from line 2, if not, enter "0")		
2	1.* Type of Unit		
	2. Resale Value		
	3. Amount Bid		
	4. Trading Profits (if you are the winning bidder, subtract line 3 from line 2, if not, enter "0")		
3	1.* Type of Unit		
	2. Resale Value		
	3. Amount Bid		
	4. Trading Profits (if you are the winning bidder, subtract line 3 from line 2, if not, enter "0")		
4	1.* Type of Unit		
	2. Resale Value		
	3. Amount Bid		
	4. Trading Profits (if you are the winning bidder, subtract line 3 from line 2, if not, enter "0")		
A.	TOTAL PROFITS (add up amounts on each line 4)		
B.	BASE EARNINGS		
C.	EARNINGS FOR THE TRADING PERIOD (A+B)		
D.	TOTAL EARNINGS AT THE END OF LAST PERIOD		
E.	TOTAL EARNINGS AT THE END OF THIS PERIOD (C+D)		

* This line was not on the BUYER'S RECORD SHEET for instruction set one.

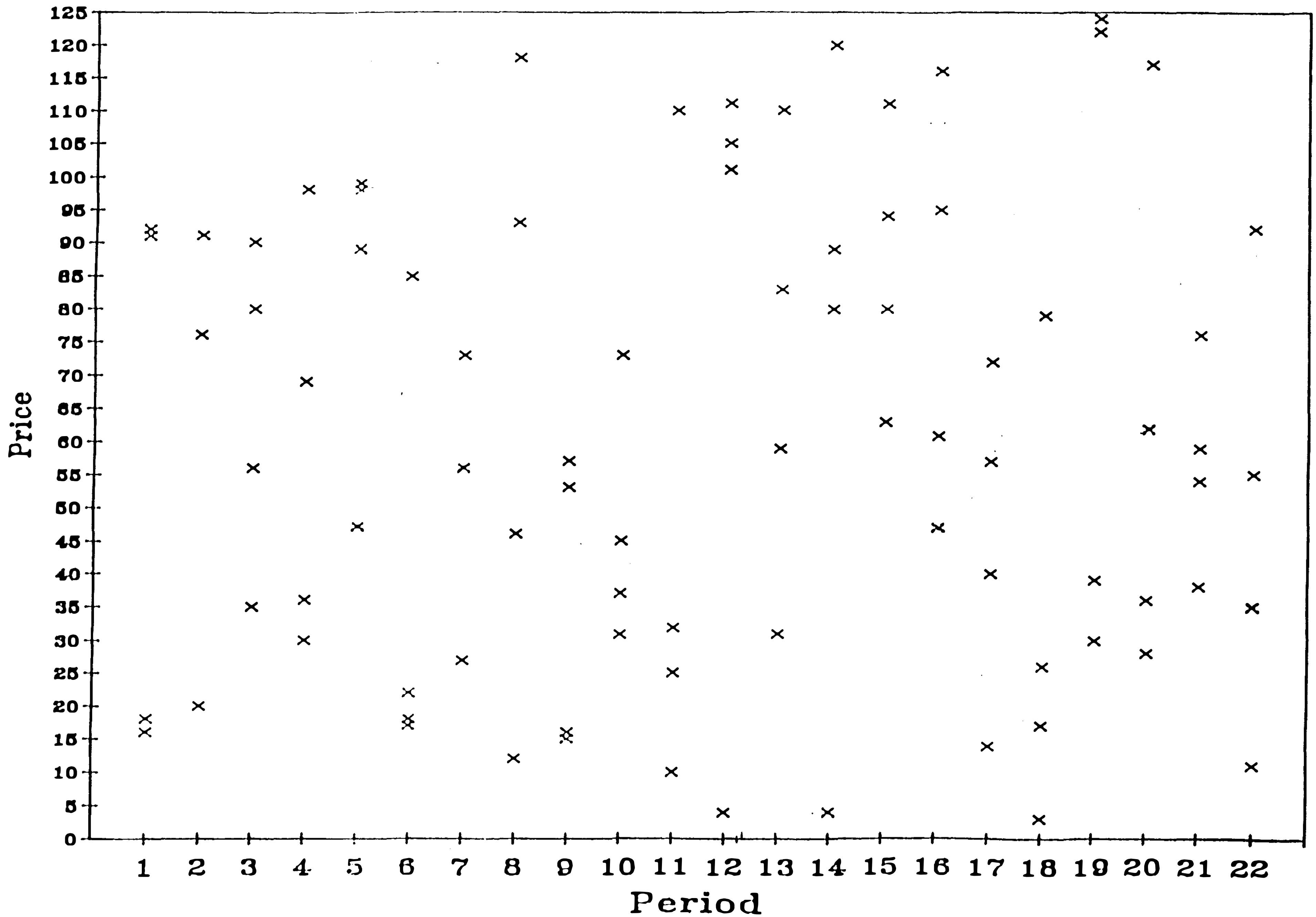
SELLER'S PROFIT SHEET

Trading Period	Amount Received
1	
2	
3	
.	
.	
.	
26	
27	
28	

APPENDIX 2

COMMON VALUES OF ITEMS FOR SALE IN EACH PERIOD

COMMON VALUES OF ITEMS BY PERIOD



APPENDIX 3

Data from Environment 1

(The column labels are read as follows: "Per" is the period number; "Sel" is the seller's trader number; "Q" is the common value of the unit the seller was endowed with; "BB" is equal to 1 if the seller chose to blindbid the item and is equal to 0 otherwise; "Prc" is the transaction price; "Buy" is the buyer's trader number.)

Market A1

Per	Sel	Q	BB	Prc	Buy
1	1	16	1	70	3
1	2	92	0	87	2
1	3	91	0	86	2
1	4	18	1	70	3
2	1	20	1	45	4
2	2	76	0	75	2
2	3	91	0	89	2
2	4	76	0	73	2
3	1	90	0	88	4
3	2	56	0	55	1
3	3	80	0	78	3
3	4	35	0	34	2
4	1	98	0	98	2
4	2	36	0	35	3
4	3	30	1	46	1
4	4	69	0	69	2
5	1	89	0	88	2
5	2	98	0	97	1
5	3	47	0	46	3
5	4	99	0	98	2
6	1	18	1	36	1
6	2	22	1	42	1
6	3	85	0	85	2
6	4	17	1	29	1
7	1	56	0	55	1
7	2	27	0	26	1
7	3	73	0	73	2
7	4	27	0	26	3
8	1	93	0	92	3
8	2	46	0	45	3
8	3	12	1	17	1
8	4	118	0	117	1
9	1	53	0	53	2
9	2	15	1	13	2
9	3	57	0	56	2
9	4	16	0	16	2
10	1	31	0	30	1
10	2	37	0	36	2
10	3	73	0	73	2
10	4	45	0	44	3
11	1	25	0	24	3
11	2	10	1	13	1
11	3	110	0	110	1
11	4	32	0	31	1
12	1	101	0	100	3
12	2	105	0	105	4
12	3	4	1	13	2
12	4	111	0	110	3
13	1	59	0	58	4
13	2	31	0	30	1
13	3	83	0	83	1
13	4	110	0	109	2
14	1	4	1	10	3
14	2	80	0	79	3
14	3	120	0	119	4
14	4	89	0	88	4
15	1	94	0	93	2
15	2	80	0	79	4
15	3	111	0	110	1
15	4	63	0	63	2
16	1	95	0	94	1
16	2	61	0	60	3
16	3	47	0	46	1
16	4	116	0	115	2

Market C1

Per	Sel	Q	BB	Prc	Buy
1	1	16	1	73	1
1	2	92	0	88	1
1	3	91	1	71	1
1	4	18	1	91	1
2	1	20	1	65	3
2	2	76	0	74	3
2	3	91	0	89	3
2	4	76	0	74	3
3	1	90	0	89	3
3	2	56	0	55	4
3	3	80	0	79	3
3	4	35	1	65	4
4	1	98	0	97	3
4	2	36	1	50	4
4	3	30	1	50	4
4	4	69	1	70	4
5	1	89	0	88	4
5	2	98	0	97	2
5	3	47	1	30	1
5	4	99	1	30	4
6	1	18	1	40	4
6	2	22	1	35	4
6	3	85	0	84	1
6	4	17	1	35	4
7	1	56	0	55	1
7	2	27	1	35	1
7	3	73	0	72	3
7	4	27	1	30	2
8	1	93	0	92	4
8	2	46	1	30	3
8	3	12	1	35	4
8	4	118	1	35	4
9	1	53	0	52	1
9	2	15	1	31	1
9	3	57	0	56	2
9	4	16	1	35	3
10	1	31	1	35	4
10	2	37	1	39	4
10	3	73	0	72	4
10	4	45	0	44	1
11	1	25	1	40	4
11	2	10	1	36	4
11	3	110	0	109	2
11	4	32	1	31	1
12	1	101	0	100	4
12	2	105	0	104	2
12	3	4	1	30	4
12	4	111	0	110	3
13	1	59	0	58	4
13	2	31	1	40	4
13	3	83	0	82	3
13	4	110	0	109	1
14	1	4	1	26	4
14	2	80	0	79	3
14	3	120	0	119	4
14	4	89	0	88	3
15	1	94	0	94	2
15	2	80	0	79	2
15	3	111	0	110	2
15	4	63	1	26	4
16	1	95	0	94	3
16	2	61	0	60	2
16	3	47	1	27	4
16	4	116	1	32	4
17	1	57	0	57	2
17	2	40	1	33	4
17	3	72	0	71	3
17	4	14	1	33	2
18	1	79	0	79	4
18	2	3	1	35	4
18	3	17	1	34	4
18	4	26	1	33	2
19	1	122	0	122	2
19	2	30	1	27	4
19	3	39	1	27	4
19	4	124	0	123	1
20	1	28	1	36	4
20	2	117	0	117	2
20	3	62	0	61	3
20	4	36	0	35	4
21	1	38	1	38	4
21	2	76	0	76	2
21	3	54	0	53	3
21	4	59	0	58	3
22	1	11	1	33	4
22	2	55	0	55	2
22	3	35	1	33	4
22	4	92	0	91	1

Market I1

Per	Sel	Q	BB	Prc	Buy
1	1	16	1	51	4
1	2	92	1	51	4
1	3	91	1	61	4
1	4	18	1	75	4
2	1	20	1	58	1
2	2	76	1	50	2
2	3	91	0	85	2
2	4	76	0	70	2
3	1	90	0	86	4
3	2	56	0	50	2
3	3	80	1	50	1
3	4	35	1	41	4
4	1	98	0	96	3
4	2	36	1	51	4
4	3	30	1	51	4
4	4	69	1	51	4
5	1	89	0	87	4
5	2	98	0	95	2
5	3	47	1	51	4
5	4	99	0	96	4
6	1	18	1	46	4
6	2	22	1	46	4
6	3	85	0	83	3
6	4	17	1	46	4
7	1	56	0	55	4
7	2	27	1	45	2
7	3	73	0	72	4
7	4	27	1	46	2
8	1	93	0	92	2
8	2	46	1	33	1
8	3	12	1	40	1
8	4	118	0	117	4
9	1	53	0	52	2
9	2	15	1	37	1
9	3	57	0	56	4
9	4	16	1	31	4
10	1	31	1	28	1
10	2	37	0	36	2
10	3	73	0	72	4
10	4	45	0	44	2
11	1	25	1	25	2
11	2	10	1	35	2
11	3	110	0	109	4
11	4	32	0	31	4
12	1	101	0	100	1
12	2	105	0	104	4
12	3	4	1	29	1
12	4	111	0	110	2
13	1	59	0	58	2
13	2	31	0	30	1
13	3	83	0	82	4
13	4	110	0	108	1
14	1	4	1	21	4
14	2	80	0	79	4
14	3	120	0	118	4
14	4	89	0	88	2
15	1	94	0	92	2
15	2	80	0	79	4
15	3	111	0	110	2
15	4	63	0	62	2
16	1	95	0	93	2
16	2	61	0	60	4
16	3	47	0	46	2
16	4	116	0	114	2
17	1	57	0	55	1
17	2	40	0	39	2
17	3	72	0	71	2
17	4	14	1	20	2
18	1	79	0	77	3
18	2	3	1	20	2
18	3	17	1	14	1
18	4	26	0	25	2
19	1	122	0	121	2
19	2	30	0	28	1
19	3	39	0	37	4
19	4	124	0	123	2
20	1	28	1	14	2
20	2	117	0	116	2
20	3	62	0	60	2
20	4	36	0	35	1
21	1	38	0	37	2
21	2	76	0	75	4
21	3	54	0	53	4
21	4	59	0	58	4
22	1	11	1	14	2
22	2	55	0	54	1
22	3	35	0	34	2
22	4	92	0	91	2

Data from Environment 2

(The column labels are read as follows: "Per" is the period number; "Sel" is the seller's trader number; "Typ" is the type of unit the seller was endowed with; "BB" is equal to 1 if the seller chose to blindbid the item and is equal to 0 otherwise; "Prc" is the transaction price; "Buy" is the buyer's trader number; "R1"-"R4" are the resale values for the corresponding type of unit for buyers 1-4, respectively. Recall that the common value of a unit, q, is given by q = 15(type - 1) + 1.)

Market A2

Per	Sel	Typ	BB	Prc	Buy	R1	R2	R3	R4
1	1	1	1	30	3	2	7	14	12
1	2	6	0	80	3	76	80	86	78
1	3	6	0	80	3	76	80	86	78
1	4	2	0	20	4	16	29	25	26
2	1	2	1	24	3	30	22	29	25
2	2	5	0	69	3	66	73	65	69
2	3	6	0	80	1	88	81	81	77
2	4	5	1	14	3	66	73	65	69
3	1	6	0	83	4	84	81	78	88
3	2	4	1	24	3	58	56	57	57
3	3	6	0	83	4	84	81	78	88
3	4	3	0	40	2	43	44	41	40
4	1	7	0	100	1	104	96	93	92
4	2	3	0	40	1	44	42	37	45
4	3	2	1	18	3	17	17	18	27
4	4	5	0	69	3	70	63	72	62
5	1	6	0	83	4	79	84	87	88
5	2	7	0	100	2	93	103	94	103
5	3	3	0	37	2	36	37	34	37
5	4	7	0	100	2	93	103	94	103
6	1	2	1	18	3	16	20	28	28
6	2	2	1	12	3	16	20	28	28
6	3	6	0	84	2	85	89	84	79
6	4	2	1	79	4	16	20	28	28
7	1	4	0	54	3	54	58	59	55
7	2	2	1	18	3	23	28	24	29
7	3	5	0	66	2	61	73	68	71
7	4	2	1	20	1	23	28	24	29
8	1	6	0	80	2	83	84	76	80
8	2	3	0	40	3	43	31	45	45
8	3	1	1	20	1	1	7	15	13
8	4	8	0	110	4	120	114	107	115
9	1	4	0	50	2	51	54	48	51
9	2	1	1	18	3	1	10	11	13
9	3	4	0	50	2	51	54	48	51
9	4	1	1	20	3	1	10	11	13
10	1	2	1	14	4	27	19	19	17
10	2	3	0	35	3	35	39	38	33
10	3	5	0	70	3	66	67	74	70
10	4	3	0	35	3	35	39	38	33
11	1	2	0	26	4	18	26	19	29
11	2	1	1	15	2	8	11	13	2
11	3	8	0	115	2	118	120	120	119
11	4	3	0	40	1	31	40	37	40
12	1	7	0	100	1	104	102	102	101
12	2	7	0	100	1	104	102	102	101
12	3	1	1	20	1	10	1	6	11
12	4	8	0	113	4	107	116	112	118
13	1	4	0	56	3	53	46	60	46
13	2	2	0	25	1	25	26	22	27
13	3	6	0	85	2	87	90*	76	85
13	4	8	0	116	4	114	107	115	120
14	1	1	1	15	1	1	7	-1	12
14	2	6	0	87	1	87	80	86	85
14	3	8	0	114	3	114	114	116	115
14	4	6	0	87	1	87	80	86	85
15	1	6	0	85	4	82	76	81	88
15	2	6	0	85	4	82	76	81	88
15	3	8	0	115	4	114	113	112	118
15	4	4	0	56	2	55	59	53	54
16	1	7	0	100	2	92	104	93	100
16	2	4	0	55	2	51	59*	53	49
16	3	3	0	39	4	38	38	36	42
16	4	8	0	116	3	115	111	118	111
17	1	4	0	54	4	54	52	47	58
17	2	3	0	42	3	44	43	44	41
17	3	5	0	70	2	61	71	67	68
17	4	1	1	15	1	15	11	8	7

Market C2

Per	Sel	Typ	BB	Prc	Buy	R1	R2	R3	R4
1	1	1	1	45	1	2	7	14	12
1	2	6	0	80	3	76	80	86	78
1	3	6	0	79	3	76	80	86	78
1	4	2	0	21	3	16	29	25	26
2	1	2	1	50	4	30	22	29	25
2	2	5	0	65	4	66	73	65	69
2	3	6	0	83	1	88	81	81	77
2	4	5	0	65	4	66	73	65	69
3	1	6	0	85	4	84	81	78	88
3	2	4	1	30	3	58	56	57	57
3	3	6	0	85	4	84	81	78	88
3	4	3	0	40	1	43	44	41	40
4	1	7	0	100	1	104	96	93	92
4	2	3	1	25	3	44	42	37	45
4	3	2	1	25	3	17	17	18	27
4	4	5	0	70	3	70	63	72	62
5	1	6	0	85	3	79	84	87	88
5	2	7	0	100	4	93	103	94	103
5	3	3	0	35	1	36	37	34	37
5	4	7	0	100	4	93	103	94	103
6	1	2	0	25	4	16	20	28	28
6	2	2	1	25	3	16	20	28	28
6	3	6	0	85	2	85	89	84	79
6	4	2	0	25	3	16	20	28	28
7	1	4	0	55	3	54	58	59	55
7	2	2	0	26	4	23	28	24	29
7	3	5	0	70	2	61	73	68	71
7	4	2	1	23	1	23	28	24	29
8	1	6	0	81	2	83	84	76	80
8	2	3	0	43	4	43	31	45	45
8	3	1	1	25	1	1	7	15	13
8	4	8	0	115	1	120	114	107	115
9	1	4	0	51	2	51	54	48	51
9	2	1	1	26	3	1	10	11	13
9	3	4	0	51	2	51	54	48	51
9	4	1	1	26	3	1	10	11	13
10	1	2	1	15	3	27	19	19	17
10	2	3	0	36	3	35	39	38	33
10	3	5	0	70	3	66	67	74	70
10	4	3	0	36	3	35	39	38	33
11	1	2	0	26	4	18	26	19	29
11	2	1	1	15	3	8	11	13	2
11	3	8	0	117	4	118	120	120	119
11	4	3	0	39	4	31	40	37	40
12	1	7	0	101	2	104	102	102	101
12	2	7	0	101	2	104	102	102	101
12	3	1	1	15	1	10	1	6	11
12	4	8	0	116	4	107	116	112	118
13	1	4	0	57	3	53	46	60	46
13	2	2	0	26	4	.25	26	22	27
13	3	6	0	85	1	-87	79	76	85
13	4	8	0	118	4	114	107	115	120
14	1	1	1	12	4	1	7	1	12
14	2	6	0	85	1	87	80	86	85
14	3	8	0	115	3	114	114	116	115
14	4	6	0	85	1	87	80	86	85
15	1	6	0	87	4	82	76	81	88
15	2	6	0	87	4	82	76	81	88
15	3	8	0	117	4	114	113	112	118
15	4	4	0	56	2	55	59	53	54
16	1	7	0	100	2	92	104	93	100
16	2	4	0	52	3	51	49	53	49
16	3	3	0	40	4	38	38	36	42
16	4	8	0	116	3	115	111	118	111
17	1	4	0	57	4	54	52	47	58
17	2	3	0	42	3	44	43	44	41
17	3	5	0	70	1	61	71*	67	68
17	4	1	0	12	1	15	11	8	7
18	1	6	0	86	4	76	81	79	88
18	2	1	1	13	3	8	2	13	6
18	3	2	0	25	2	22	27	16	19
18	4	2	0	25	2	22	27	16	19
19	1	8	0	116	4	115	111	111	117
19	2	2	0	27	4	25	24	26	30
19	3	3	0	36	4	32	36	34	37
19	4	8	0	116	4	115	111	111	117
20	1	2	0	26	3	19	22	28	21
20	2	8	0	112	2	113	115	107	108
20	3	4	0	51	3	49	47	52	46
20	4	3	0	41	1	43	31	40	34
21	1	3	0	42	4	32	36	36	43
21	2	5	0	71	2	70	75	62	67
21	3	4	0	55	1	57	50	53	49
21	4	4	0	55	1	57	50	53	49
22	1	1	1	14	4	9	5	5	15
22	2	4	0	57	3	56	57	59	57
22	3	3	0	40	3	39	42	42	32
22	4	6	0	82	2	83	85	80	78

Market I2

Per	Sel	Typ	BB	Prc	Buy	R1	R2	R3	R4
1	1	1	1	40	3	2	7	14	12
1	2	6	0	83	3	76	80	86	78
1	3	6	0	84	3	76	80	86	78
1	4	2	1	31	3	16	29	25	26
2	1	2	1	25	4	30	22	29	25
2	2	5	0	70	2	66	73	65	69
2	3	6	0	84	1	88	81	81	77
2	4	5	0	70	2	66	73	65	69
3	1	6	0	83	4	84	81	78	88
3	2	4	0	55	4	58	56	57	57
3	3	6	0	85	4	84	81	78	88
3	4	3	1	26	4	43	44	41	40
4	1	7	0	99	1	104	96	93	92
4	2	3	0	40	4	44	42	37	45
4	3	2	1	26	4	17	17	18	27
4	4	5	0	70	3	70	63	72	62
5	1	6	0	84	4	79	84	87	88
5	2	7	0	100	2	93	103	94	103
5	3	3	0	35	1	36	37	34	37
5	4	7	0	100	2	93	103	94	103
6	1	2	1	27	3	16	20	28	28
6	2	2	1	27	4	16	20	28	28
6	3	6	0	85	2	85	89	84	79
6	4	2	1	28	4	16	20	28	28

7	1	4	0	56	3	54	58	59	55
7	2	2	1	25	4	23	28	24	29
7	3	5	0	70	2	61	73	68	71
7	4	2	1	26	4	23	28	24	29
8	1	6	0	82	1	83	84	76	80
8	2	3	0	41	3	43	31	45	45
8	3	1	1	26	1	1	7	15	13
8	4	8	0	115	1	120	114	107	115
9	1	4	0	51	2	51	54	48	51
9	2	1	1	24	3	1	10	11	13
9	3	4	0	52	2	51	54	48	51
9	4	1	1	24	3	1	10	11	13
10	1	2	1	22	1	27	19	19	17
10	2	3	0	37	3	35	39	38	33
10	3	5	0	70	3	66	67	74	70
10	4	3	0	37	3	35	39	38	33
11	1	2	1	24	4	18	26	19	29
11	2	1	1	24	4	8	11	13	2
11	3	8	0	115	4	118	120	120	119
11	4	3	0	40	4	31	40	37	40
12	1	7	0	102	2	104	102	102	101
12	2	7	0	102	2	104	102	102	101
12	3	1	1	20	3	10	1	6	11
12	4	8	0	115	4	107	116	112	118
13	1	4	0	55	3	53	46	60	46
13	2	2	1	19	1	25	26	22	27
13	3	6	0	85	1	87	79	76	85
13	4	8	0	115	4	114	107	115	120
14	1	1	1	20	1	1	7	1	12
14	2	6	0	86	1	87	80	86	85
14	3	8	0	114	3	114	114	116	115
14	4	6	0	86	1	87	80	86	85
15	1	6	0	85	4	82	76	81	88
15	2	6	0	85	4	82	76	81	88
15	3	8	0	115	4	114	113	112	118
15	4	4	0	57	2	55	59	53	54
16	1	7	0	102	2	92	104	93	100
16	2	4	0	52	3	51	49	53	49
16	3	3	0	40	4	38	38	36	42
16	4	8	0	114	3	115	111	118	111
17	1	4	0	54	4	54	52	47	58
17	2	3	0	41	1	44	43	44	41
17	3	5	0	69	2	61	71	67	68
17	4	1	1	20	3	15	11	8	7
18	1	6	0	84	4	76	81	79	88
18	2	1	1	18	1	8	2	13	6
18	3	2	1	18	1	22	27	16	19
18	4	2	0	25	2	22	27	16	19
19	1	8	0	114	4	115	111	111	117
19	2	2	0	25	4	25	24	26	30
19	3	3	0	37	4	32	36	34	37
19	4	8	0	115	4	115	111	111	117
20	1	2	0	25	3	19	22	28	21
20	2	8	0	113	2	113	115	107	108
20	3	4	0	51	3	49	47	52	46
20	4	3	0	40	1	43	31	40	34
21	1	3	0	40	4	32	36	36	43
21	2	5	0	73	2	70	75	62	67
21	3	4	0	56	1	57	50	53	49
21	4	4	0	56	1	57	50	53	49
22	1	1	1	12	4	9	5	5	15
22	2	4	0	55	3	56	57	59	57
22	3	3	0	40	3	39	42	42	32
22	4	6	0	83	2	83	85	80	78

* In three instances a buyer misrecorded his resale value. This occured in Market A2 when buyer 2 recorded his valuation for a type 6 item in period 13 as 90 when it should have been 79 and in period 16, when the same buyer misrecorded his valuation for s type 6 item as 59 instead of 49. The third instance occurred in Market C2. In period 17, buyer 1 recorded his valuation as 72 when it should have been 61. In these three cases, we use the recorded value instead of the actual resale value when we analyze the data.