NÚMERO 404

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DICIEMBRE 2007

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Acknowledgments

We would like to thank A. Cabrales, A. Hernando-Veciana, D. Kaplan, C. Lever, D. Moreno, T. Sharma and participants of seminars at Universidad Carlos III and Universidad de Alicante for valuable comments. We also thank Pablo Riveroll for his research assistance and Abelardo De León for programming assistance. Part of this research has been conducted while Gomberg was visiting Universidad Carlos III de Madrid. We also thank Conacyt (418880-S) for financial support of the experiments. Gomberg thanks the Asociación Mexicana de Cultura for financial support.

Abstract

This paper reports results of an experimental study of uniform multi-unit auctions in an environment of publicly known common values. We .nd that the bidding behavior exhibits two clear regularities: agents consistently play weakly dominated strategies by overbidding on the first unit and have difficulty coordinating on high payoff (low auction revenue) equilibria. In addition, the nature of prior experience seems to have a crucial impact on behavior: subjects with experience in single-unit second-price auctions do not overbid, while subjects with experience in multi-unit uniform-price auctions are better at reducing demand to achieve higher payoff.

Resumen

Este trabajo reporta los resultados de un estudio experimental de una subasta uniforme con múltiples unidades, donde las valoraciones son comunes y sin incertidumbre. Encontramos que el comportamiento de los agentes al someter sus posturas exhibe dos claras regularidades: los agentes consistentemente juegan estrategias débilmente dominadas al someter posturas por encima de la valoración de la primera unidad y tienen problemas para coordinar en el equilibrio que les deriva un alto pago (o de bajo ingreso para el vendedor).

Adicionalmente, la naturaleza de la experiencia previa parece tener un impacto crucial en el comportamiento: los sujetos con experiencia en subastas de una unidad no parecen someter postura por encima de la valoración, mientras que sujetos con experiencia en subastas de múltiples unidades son mejores reduciendo sus demandas para lograr un mejor pago.

Uniform-Price Auctions without Exogenous Uncertainty: An experimental study*

by

Alexander Elbittar and Andrei Gomberg

Abstract

This paper reports results of an experimental study of uniform multi-unit auctions in an environment of publicly known common values. We find that the bidding behavior exhibits two clear regularities: agents consistently play weakly dominated strategies by overbidding on the first unit and have difficulty coordinating on high payoff (low auction revenue) equilibria. In addition, the nature of prior experience seems to have a crucial impact on behavior: subjects with experience in single-unit second-price auctions do not overbid, while subjects with experience in multi-unit uniform-price auctions are better at reducing demand to achieve higher payoff.

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1 Introduction

In this paper we report results of a laboratory study of uniform-price multi-unit auctions conducted in an extremely simple environment: that of common and perfectly observable value. In essence, we auction bank notes. Despite seeming simplicity of the environment we observe a number of interesting regularities that seem to provide some evidence both for the nature of agent learning how to play the game and about equilibrium selection.

The uniform-price auctions have been used extensively, having, for instance, been chosen by the U.S. Treasury Department to sell government bonds, and the overall experience has often been successful, leading to increased auctioned revenues compared to alternative designs, as claimed, for instance, by Malvey and Archibald (1998). The basic set-up is to auction a number of identical objects ("units") and to allow bidders to submit a schedule specifying how many of these they'd be willing to purchase at each given price. Each agent submits as many separate bids as there are units to be auctioned. The highest bids get allocated the objects (ties resolved randomly), but only have to pay for each unit the uniform market-clearing price.

At a first glance it seems an easy generalization of the standard Vickrey (1961) second-price auction, however, already in that original paper Vickrey himself observed that when individual agents may bid for multiple units, the uniform-price auction is not the appropriate extension. Since then, Wilson (1979), Back and Zender (1993), Ausubel and Cramton (1996), Engelbrecht-Wiggans and Kahn (2005), among others, have shown that in a wide variety of environments uniform-price (and the related simultaneous-bid ascending) auctions may allow for equilibrium bidder collusion leading to low seller revenue. Notably, some recent studies (such as Kremer and Nyborg 2004) presented theoretical reasons for why the low-revenue equilibria might not be a severe problem in practice. This served as our motivation to consider an artificial environment where the low-revenue equilibria are unambiguously predicted by theory and to examine if it would be possible to successfully implement it in the lab.

To understand why low (even zero) revenue might occur, observe that even in a standard one-unit second-price auction there are multiple Nash equilibria. Indeed, consider a two-bidder auction selling two one-dollar bills. If I believe that my opponent bids exactly two dollars, I am indifferent between any bid: if I am bidding less than two dollars I will loose and pay nothing; if I am bidding above two dollars then I will win, and exchange the two dollars for the same. Clearly, bidding nothing is *a* best response. On the other hand, if I believe that my opponent is bidding nothing, then bidding any amount above zero - including two dollars - is also a best response (it gets me the two dollars and does not affect what I am paying). Thus, one agent bidding zero and another agent bidding two dollars is a Nash equilibrium, which results in a zero revenue for the auctioneer. Of course, as is well-known since Vickrey (1961), this particular equilibrium is unappealing, since it involves one of the players playing a weakly dominated strategy. In fact, bidding two dollars for the two dollar bills is the weakly dominant strategy for all agents. Thus, in the absence of outside collusion, if all agents play their dominant strategies, the auctioneer is guaranteed the full revenue (i.e., he'd sell the two dollars for two dollars). However, suppose now that instead of selling the two bills together we allow them to be sold separately in a two-unit uniform-price auction, with the market-clearing price set equal to the third highest (highest loosing) bid. It is easy to see that bidding a dollar for each dollar bill is a best response to the symmetric action of one's opponent, so the full-revenue equilibrium is still there. However, each agent bidding a dollar for one bill and declining to bid above zero for the second bill is also an equilibrium (bidding anywhere between a zero and a dollar on the second bill only raises the price you pay for the bill you'd be getting anyway, while raising it above the dollar would give you the second bill, but force you to pay exactly a dollar for each of the bills), results in a zero revenue (each agent gets a dollar bill free), and this time there is no dominance argument to get rid of it (on the contrary, it can be shown that in this particular setting this is the dominance criterion may lead to). It is the possibility of such *equilibrium collusion* in a uniform-price auction that makes it unattractive as an allocation mechanism.

Our objective in this paper is to see whether such equilibrium collusion does indeed materialize (and if it does, then under which conditions) in a simple laboratory environment. For this purpose we have, essentially, tried to auction cash to subjects, while varying the number of cash units on sale. In the process we discovered that cooperating on low-revenue equilibria is far from straightforwardly achieved in a lab and that past experience and/or an opportunity to communicate outside the lab seems to be crucial for it to occur.

In fact, not only the agents have a difficulty of achieving equilibrium cooperation and high payoffs, but subjects also tend to overpay, since they actually, on average, overbid, consistently playing a clearly dominated strategy. This, of course, recalls the well-established experimental finding of Kagel et al. (1987) about the consistent overbidding in the second-price auctions, which has itself spawned an important recent literature (see Kagel and Levin 1993, or Harstad 2000). However, we observe that in the single-unit second-price auction this behavior does eventually get almost eliminated, though it persistently survives in multi-unit treatments. This observation seems to favor the hypothesis proposed, for instance, in the above-cited papers, that overbidding is simply an error that persists due to lack of punishment: in second-unit common-value no-uncertainty auctions where everybody overbids agents are almost guaranteed to loose money every time they engage in this behavior, whereas in the other treatments actually loosing money is rarer.

The experimental literature on uniform auctions is extensive and cannot be fully surveyed here. In terms of experimental design our work is closely related to Kagel and Levin (2001). However, whereas they choose to eliminate strategic uncertainty (by having subjects play against computers following transparent strategies), but retain exogenous uncertainty of object value, we eliminate the latter, but preserve the former (our subjects play against each other, but share a common and known object value). A number of other experimental studies (including the laboratory experiments of Alsemgeest *et al.* 1998 and Engelmann and Grimm 2004 and the field experiment of List and Lucking-Reiley 2000) included two-person two-unit uniform price auctions with actual human bidders in independent private-value setting as one of the treatments..Our results on the role of communication also recall those of Goswami et al. (1996) in a related but more complicated no-uncertainty common-value setting, which have, however been more recently partially contradicted by Sade et al. (2006). Unlike the above-cited papers, which concentrate on revenue comparisons in different auction formats, the focus of our paper is on comparing, just in the context of the uniform price auctions, closely related environments with clearly distinct equilibrium predictions. In this respect, our design is similar to that of Engelbrecht-Wiggans et al. (2006), who in a context of a field experiment report the results of uniform-price auctions of two objects (with unobservable values) with varying numbers of human bidders. Unlike them, keep the number of bidders constant, but vary the number of objects sold in a laboratory environment without uncertainty about the monetary value of objects sold, which, leads to sharper theoretical distinctions between the treatments.

To sum up our empirical findings, most agents in all uniform-price auctions with one or more units start by overbidding strongly on the first unit and doing little to reduce the demand for further units (in general, auctions with inexperienced subjects result, on average, in greater than full revenue for the auctioneers). With experience, agents who had been playing a second-price one-unit auction tend to gradually (if very slowly) learn not to overbid, and if we call them for another session later, the overbidding largely disappears. In contrast, agents playing multi-unit uniform-price auctions essentially never learn and continue overbidding on the first unit (at least, within the confines of multiple twenty-period lab sessions). On the other hand, given past experience playing a multi-unit auction (and an opportunity to communicate during the week or two between sessions), the subjects become much more "aggressively cooperative" in reducing demands for second and further units, occasionally achieving the high-payoff (low-revenue) auction plays. Strikingly, the three-unit treatment, which in theory provides for the most favorable conditions for demand reduction, is not clearly empirically different in this respect from the other multi-unit treatments (in fact, similar patterns are observable even in the two-unit treatment, where demand reduction rarely leads to improved payoffs). Another notable observation is that, the subjects with experience in single-unit second-price auction, when placed in a multi-unit uniform-price environment behave like inexperienced subjects. We believe that the findings can be explained by agents a) learning not to play dominated strategies through some sort of a payoff "reinforcement" mechanism and b) learning to coordinate on high-payoff equilibria through experience and/or out-of-lab communication (both these conjectures require a further study).

The rest of this paper is organized as follows. Section 2 presents the description of the game and of its equilibria. Section 3 explains the experimental design. Section 4 presents experimental findings and Section 5 concludes.

2 The Game

Throughout the paper we shall restrict our attention to a fixed number of three bidders $I = \{1, 2, 3\}$. In every auction we consider selling n identical and perfectly substitutable objects valued at $v \in [0, \bar{v}]$. This value is common knowledge among the bidders who can submit as many bids as there are objects on sale. We shall denote the individual vector of bids as $b_i = (b_{i1}, b_{i2}, ..., b_{in}) \in [0, \bar{b}]^n$ $(i \in I)$, and shall, without loss of generality, assume that these are ordered: $k > j$ implies $b_j \geq b_k$. As is standard in uniform-price auctions, the top n bids get assigned the object at the same market-clearing price p (we shall assume that all ties are resolved randomly). Of course, since the objects on sale are discrete, one can choose this price to be equal either to the highest loosing ($(n+1)$st-highest), or the lowest winning (nth-highest) bid. As shown in Kremer and Nyborg (2004), the latter choice substantially limits equilibrium revenue reduction. In contrast, if we choose the former, no such effect would be theoretically predicted, presumably making it easier to detect underbidding and revenue reduction in the lab. Therefore, we shall always set the price equal to the *highest loosing* bid:

$$p = \max \{b_{ij} : \# \{b_{kl} : b_{kl} \geq b_{ij}\} > n\}$$

In every auction, therefore, an agent's payoff will be equal to $(v - p)$ times the number of objects s/he wins and the revenue of the seller is equal to np.

As is discussed in the introduction, in general in all auctions of this type there is a continuum of Nash equilibria. However, eliminating weakly dominated strategies allows one to substantially reduce the equilibrium set. Going back to Vickrey (1961) weak dominance has been considered a suitable refinement for analyzing second-price and uniform auctions. In addition, when weak dominance does not suffice to define a prediction, we shall consider a single extra round of iterated elimination of dominated strategies (i.e., we shall only consider equilibria in undominated strategies that do not involve playing strategies that are weakly dominated if bidders assume that their competitors would never play weakly dominated strategies). The following summarizes theoretical predictions to be tested in this paper (many of these are, of course, well-known, and are simply adapted to the present setting) :

Proposition 1 *(i) Given any number of objects n, for each agent $i \in I = \{1, 2, 3\}$ any* *strategy* $b_i = (b_{i1}, b_{i2}, ...b_{in})$ *such that* $b_{i1} \neq v$ *is weakly dominated by* $b'_i = (v, b_{i2}, ...b_{in})$.

(ii) If $n = 1$ *or* $n = 2$ *then in every Nash equilibrium in weakly undominated strategies the clearing price* $p = v$.

(iii) If $n = 3$ *then if agents eliminate all weakly dominated strategies of other bidders, the strategy* $b_i = (v, 0, 0)$ *weakly dominates* (v, x, y) *for any* $v > x, y > 0$. *This implies the clearing price* $p = 0$.

(iv) If $n = 4$ *then for every agent bidding* $b_i = (b_1, b_2, b_3, b_4)$ *such that* $b_3 b_4 \neq 0$ *is weakly dominated by bidding* $(b_1, b_2, 0, 0)$ *in every pure strategy Nash equilibrium there must be at least one agent bidding* $b_{i2} \geq \frac{v}{2}$.

Proof. *(i) this follows the standard dominance argument for second-price auctions. Consider the choice vector of bids* b_1 *by agent 1 (as the game is symmetric this is without loss of generality), given any profile of bids* b_2,b_3 *If the total number of bids* $b_{jk} > v$ $(j \neq 1)$ *is smaller than* n *then setting* $b_{11} \geq v$ *gains an object at some price* $p \leq v$ *that is independent of* b_{11}. *Otherwise, if the number of bids* $b_{jk} > v$ $(j \neq 1)$ *is bigger than or equal to* n, *any* $b_{11} > v$ *guarantees that* $p \geq v$, *in which case the agent weakly prefers to have chosen any* $b_{11} \leq v$. *Clearly, no matter what the bids by others,* $b_1 = (v, x, y)$ *dominates* (b, x, y) *for any* $v \geq x, y \geq 0$ *and any* $b \neq v$.

(ii) if $n = 1, 2$ *and all agents play a weakly undominated strategy, there are no bids above* v, *and, at least, three bids* $b_{jk} = v$, *which guarantees that the price* $p = v$ *no matter what else the bidders do.*

(iii) if $n = 3$ *and all other agents play a weakly undominated strategy then there are no bids above* v *and, at least, two bids by other agents such that* $b_{jk} = v$. *Then the only way for an agent 1 (once again, without loss of generality) to win more than one object is by setting* $b_{11} \geq b_{12} \geq v$. *But that guarantees that the price* $p \geq v$ *in which case he can't have positive payoffs . Furthermore, any bid* b_{12} *is either the fourth-highest (in which it determines the price), or not: in the former case agent 1 prefers to set it as low as possible, and in the latter s/he does not care what it is. Hence, setting* $b_1 = (x, 0, 0)$ *weakly dominates any* $b'_1 = (x, y, z), x \geq y, z > 0$, *assuming the agent expects others to play weakly dominant strategies.*

(iv) if other agents play a weakly undominated strategy then there are, at least, 2 bids $b_{ik} = v$. *Therefore, the only way for a bidder* j *to make his third bid winning is by setting* $b_{j1} \geq b_{j2} \geq b_{j3} \geq v$, *so that he can't have positive payoffs from winning (the rest of the argument is as in (iii). Furthermore, suppose for all agents* $i \neq j$ *for all* $k = 2, 3, 4$, $b_{ik} < \frac{v}{2}$. *Clearly, setting any* $b_{j1} \geq b_{j2} = v$ *gains two objects at the price* $p < \frac{v}{2}$, *ensuring a payoff of strictly more than* v, *which is strictly bigger than the payoff from winning a single object at any non-negative price. Therefore, if all three agents propose setting* $b_{j2} < \frac{v}{2}$ *there will always exist a profitable deviation by an agent not winning more than one object. It remains to consider the strategy profiles with tied second bids, where all agents have at least a 1/3 probability of gaining the second object. Clearly, an arbitrarily*

small increase of the second bid by any agent would result in him/her getting the second object for sure, strictly increasing the payoff, so such a tie at less than half of value would still not be an equilibrium. ■

In words this proposition states that in all uniform auctions considered, agents should bid honestly for at least one object. In one- or two-unit auctions this implies that the seller will always extract full surplus from the bidders. In three-unit auctions, however, if agents believe others won't play dominated strategies (in this case, will submit, at least, one full value bid each), the dominant thing for them to do is to submit only one positive bid, which, of course, results in zero revenue for the sellers if every agent does it. In the four-unit auction the dominance criterion does not lead to a unique equilibrium payoff profile, as the second-highest bids cannot be pinned down. However, the competition for the fourth object should, in equilibrium, be pushing second bids up.

3 Experimental Design

Our experimental design attempts to test these theoretical predictions in a controlled laboratory setting. All experimental sessions were conducted at Instituto Tecnológico Autónomo de México (ITAM) in Mexico City and the subjects were undergraduates recruited in introductory economics courses. The experiments were computer-administered. We conducted a total of 23 uniform-price auction sessions, with 15 to 30 participants per session. Each session consisted of 5 practice periods followed by 20 periods of play for money. The total duration of a session (including detailed discussion of instructions and answering subjects' questions) was somewhat under 2 hours.

During each session a constant number n ($n = 1, 2, 3, 4, 6, 15$) of identical objects were repeatedly auctioned to each three-person group using the above-described uniform-price format ($n-$unit treatment). In each period agents were randomly matched into groups of three to participate in an auction. The total value on sale to each group randomly varied each period between MN\$20 and MN\$100 Mexican pesos (slightly less than US\$2 to US\$10). This value was announced to agents at the beginning of each session before they made their bids and they were explicitly told that other members of the group received the same announcement. The agents had to make n non-negative bids (not exceeding $\frac{100}{n}$). After each round, agents were given information about the winning bids and the clearing price (the highest loosing bid). The received no other feedback (in particular, they did not get any information on any bids below the highest loosing).

At the beginning of each session agents received a balance of MN\$60 pesos. All earnings/losses were added each period to this balance. If a subject's balance fell below MN\$20 pesos s/he was not allowed to bid further and was paid that remaining balance (in a couple of cases, where a subject's balance fell below zero - in no case this amount was worth

Units	Mostly No Experience	Relevant Experience Recruitment	Other Experience Recruitment
1	4 sessions	1 session	1 session (3-unit experience)
2	2 sessions	2 sessions	
3	4 sessions	2 sessions	1 session (1-unit experience)
4	2 sessions	2 sessions	
6	1 session		
15	1 session		

Table 1: Treatments Run

more than a few U.S. cents - they were paid nothing). Since in this case the number of subjects in the room was no longer divisible by 3, some subjects would be randomly chosen each period not to participate (consequently, up to the period 19, the termination time remained random for subjects in most sessions). After session 20 the accumulated balance was paid out to subjects in cash.

In order to study the impact of experience and communication on outcomes, we deliberately recruited subjects who had participated in earlier sessions. To encourage them returning, those who had participated in at least one prior session were offered an additional MN$60 participation fee for each new session they took part in. In order to facilitate communication among experienced subjects we made a particular effort to recruit participants in a given prior session to return together for another session. In these repeat sessions, experienced subjects were mixed with new inexperienced subjects. No attempt was made to prevent pre-session discussion of the experiment (in fact, this was repeatedly observed). As we were interested in impact of different types of experience, in two sessions we made an effort to recruit subjects with experience in one treatment to participate in another treatment (in no case were agents warned in advance about the exact treatment they would participate in). In addition, a number of experienced subjects participated in some later sessions even when no effort to recruit experienced agents was made. It should be noted, that, given the relatively small student body of ITAM and the fact that repeat sessions were run shortly after the initial sessions with then-inexperienced subjects, we had no way of preventing communication among subjects during the period between sessions even if we so desired. In fact, we have anecdotal evidence that such communication did occur. Overall, there does not exist a way for us, without further experiments, to separate the effect of experience per se, and that of communication between subjects during the period between sessions. Even though, for brevity, in what follows we shall consistently refer to "experience", we are cognizant of the possibility that what matters is the ability of subjects to communicate outside the lab.

Table 1 summarizes the treatments we ran. As is easily seen, the bulk of the auctions was run in 1-, 2-, 3-, or 4-unit formats. Two pilot sessions with 6 and 15 units each were also run, but there was no follow up and these remain of limited interest to us for the moment (though possibly usable in future research).

4 Results

In this section we present the results of the experimental sessions. We concentrate on, firstly, trying to determine whether the theoretical predictions of Proposition 1 are observable in the lab and, secondly, on the role experience (both within a session and in prior sessions) plays in determining the subject behavior. Our results, broadly, show two phenomena: agents tend to overbid on their higher bid, and, though reducing the size of their further bids (we shall call this demand reduction in what follows), do not, most of the time, do this sufficiently to reap high predicted payoffs. Table 2 presents the summary statistics for the bids expressed as a proportion of the object's value for all subjects throughout the 23 sessions..

The first observation we encountered was that subjects had difficulty earning money in this experiment, even when lucrative low-revenue equilibria were theoretically predicted. As the subjects received a MN$60 peso show-up fee which they could have safely preserved by never overbidding (bidding above value) in any auction, playing weakly dominant strategies would imply that no agent ever received a total payoff of less then MN$60 pesos. In fact, for the one- and two-unit auctions, in which the object price should be equal to value, this payoff is indeed what proposition 1 suggests for the subject payoffs after any number of experimental sessions. In contrast, in 3-unit auctions the proposition suggests that in each auction one object should be assigned to each subject at no cost. Since the total value of objects on sale in each period averaged $60 pesos, this surplus (shared equally among the three bidders in each auction) should have accumulated, on average, to MN$400 pesos after 20 rounds. The total predicted payoff for these sessions (including the show-up fee) was, therefore, equal to MN$460 (over US$40) per agent. For the four-unit auction proposition 1 provides not precise prediction for payoffs, though the low revenue equilibria, as in the three-unit case, are still possible.

Table 2 presents the empirically observed average payoffs (in pesos, excluding the additional MN$60-peso show-up fee paid to experienced subjects for a repeat participation) per subject for each session. A striking observation here is how poorly the subjects perform. Of the 16 sessions with subjects primarily inexperienced in the same auction type in only 1 (a four-unit session) agents manage to gain, on average, a modest MN$5 pesos over the show-up fee. There is only one other (2-unit) session where agents practically don't loose money. In the remaining 14 sessions agents on average lost between 3 and 18 pesos, where inaction would have guaranteed them no losses! The improvement in sessions for which multiple subjects with experience in the same type of the auction were deliberately recruited is noticeable: of the 7 such sessions in only 2 there are any losses and in all four

3- and 4-unit sessions there are average gains of at least \$6 pesos over the course of the experiment. In one of these sessions (a 4 unit session) the gains are, in fact, quite striking: each agent went home with, on average, \$MN210 pesos (almost US\$20, nearly half of the maximum predicted). Still, in the other three of these sessions payoffs of the magnitude comparable to the prediction did no materialize

To get some feeling for this outcome, we may look at the summary statistics in Tables 3 and 4. The statistics are suggestive. The highest bids, on average, show marked overbidding (though this seems smaller for the one-unit second-price auctions). There is also noticeable, bid reduction for lower bids (especially pronounced in 4-unit auctions), with extremely high standard deviations reflecting bimodal bid distributions. The picture becomes even more suggestive if we only consider subjects with prior experience, which we show in Table 2.

A couple of observations can be made even at this point. Firstly, experience eliminates dominated strategy play in one-unit second-price auctions (subjects with relevant experience nearly always bid almost exactly value). Furthermore, experience in multi-unit auctions seems to dramatically increase demand reduction on lower bids (high standard deviations still being observed) in all treatments (even in the two-unit auctions where this does not normally result in higher payoffs). Interestingly, subjects with experience in single-unit auctions do not seem to reduce demand when given a chance to play in a three-unit auction.

Table 5 reports how often bidders came close to full demand reduction (predicted by theory, at least for the three-unit auction). Few subjects ever submit all their bids this low. However, the full demand reduction becomes fairly common on the second bid, especially with experience: 27% of bids by bidders with relevant experience in the 2-unit treatment, 28% in the 3-unit treatment, and 40% of bids in the 4-unit treatment belong to this category. Interestingly, only in the 4-unit treatment there is a further substantial increase of such low bids: nearly 62% of third-highest bids in the 4-unit auctions do not exceed MN\$1 peso. This further reduction suggests that second-highest bids might have been elevated by competition for the 4th unit. Somewhat surprisingly, the size of demand reduction is not particularly high in the three-unit auctions, where it is the strongest theoretical prediction. In fact, in 2-unit auctions, where zero second-highest bids, though not impossible in equilibrium, should not (and do not) normally affect payoffs, the pattern is comparable.

Units	Mostly No Experience	Relevant Experience Recruitment	Other Experience Recruitment
1	45/54/57/56	56	55
2	51/60	61/51	
3	45/42/54/49	90/66	47
4	65/46	210/71	
6	46		
15	46		

Table 2: Average Payoffs per subject in each session (pesos)

Auction		Highest bid	2nd bid	3rd bid	4th bid	5th bid	Further
1 Unit	mean	1.035					
	s.d.	(0.283)					
	obs.	2181					
2 Units	mean	1.110	0.760				
	s.d.	(0.356)	(0.446)				
	obs.	1854	1854				
3 Units	mean	1.159	0.856	0.726			
	s.d.	(0.423)	(0.472)	(0.445)			
	obs.	3045	3045	3045			
4 Units	mean	1.211	0.762	0.591	0.527		
	s.d.	(0.489)	(0.552)	(0.536)	(0.492)		
	obs.	1122	1122	1122	1122		
6 Units	mean	1.189	1.122	1.019	0.936	0.873	0.809
	s.d.	(0.397)	(0.364)	(0.381)	(0.351)	(0.356)	(0.343)
	obs.	474	474	474	474	474	474
15 Units	mean	1.188	1.159	1.137	1.102	1.053	0.804
	s.d.	(0.472)	(0.428)	(0.398)	(0.363)	(0.362)	(0.472)
	obs.	477	477	477	477	477	4770

Table 3: All Bidders. Average bids as a proportion of value

Auction		1st bid	2nd bid	3rd bid	4th bid
1 unit, 1-unit experience	mean	1.001			
	s.d.	(0.057)			
	obs.	319			
1 unit, 3-unit experience	mean	0.983			
	s.d.	(0.235)			
	obs.	287			
2 unit, 2-unit experience	mean	1.076	0.550		
	s.d.	(0.232)	(0.436)		
	obs.	456	456		
3 unit, 1-unit experience	mean	1.091	0.920	0.827	
	s.d.	(0.287)	(0.288)	(0.308)	
	obs.	287	287	287	
3 unit, 3-unit experience	mean	1.154	0.594	0.503	
	s.d.	(0.381)	(0.451)	(0.431)	
	obs.	696	696	696	
4 unit, 4-unit experience	mean	1.187	0.540	0.335	0.303
	s.d.	(0.410)	(0.469)	(0.433)	(0.408)
	obs.	315	315	315	315

Table 4: Experienced Bidders Only. Average bids as a proportion of value

Units/Experience bid	Highest	2nd bid	3rd bid	4th bid
1 unit	1			
total observations	2181			
%	0.0%			
2 unit no experience	4	123		
total observations	1398	1398		
%	0.3%	8.8%		
2 unit no 2 unit experience	0	127		
total observations	456	456		
%	0.0%	27.9%		
3 unit no 3 unit experience	7	181	271	
total observations	2349	2349	2349	
%	0.3%	7.7%	11.5%	
3 unit 3 unit experience	2	200	235	
total observations	696	696	696	
%	0.3%	28.7%	33.8%	
4 unit no 4 unit experience	1	151	216	225
total observations	807	807	807	807
%	0.1%	18.7%	26.8%	27.9%
4 unit 4 unit experience	0	127	195	203
total observations	315	315	315	315
%	0.0%	40.3%	61.9%	64.4%

Table 5: Bids equal to or lower than 1 peso

Independent Variable	Coefficient	Stand. Error
constant	1.0583*	0.2813
exp1	-0.1140**	0.0358
exp2	-0.0540**	0.0172
exp3	-0.0302	0.0358
exp4	0.0134	0.0494
1un × period	-0.0039**	0.0014
2unit	0.0840*	0.0347
2un × period	-0.0001	0.0013
3unit	0.0911*	0.0427
3un × period	0.0025	0.0017
4unit	0.1019	0.0622
4un × period	0.0042	0.0022
6unit	0.2148**	0.0708
6un × period	-0.0116**	0.0032
15unit	0.0857	0.0645
15un × period	0.0017	0.0048
bankrupt	0.2962**	0.0586
exppergroup	0.0638	0.0386

*: $p<0.05$, **: $p<0.01$

Table 6: Highest bid as a proportion of value

In order to receive a more detailed picture of the highest bids, we ran a GLS regression (random effects model accounting for individual variability) with the dependent variable being the bid (expressed as a proportion of value) and independent binary variables ($\exp 1, ... \exp 4$) for prior experience in various treatments, current treatment ($2unit, ..15unit$), early exit due to bankruptcy (*bankrupt*, to account for subject selection during sessions) and continuous variables for auction rounds (*period*) interacted with the treatment (to account for the possibility of different bid dynamics in different auction types).[1] In addition, we used a variable (*exppergroup*), to denote the proportion of experienced subjects in each session. Since the dependent variable is expressed as a proportion of value, the predicted honest bid corresponds to it equalling to 1. The results of the regression are presented in Table 6.

The results of this regression are suggestive of a certain learning pattern. Initially the subjects (even those who would never go bankrupt) show a clear pattern of overbidding across all the treatments (the constant is significantly different from 1). The smallest overbid corresponds to the one-unit treatment, with generally higher overbids in multi-unit treatments (significantly higher in the 2-,3- and 6 unit auction). The only variables with a significant effect reducing the overbid are prior experience in 1- and 2-unit auction (the latter effect is relatively small) and the dynamic coefficient in the 1-unit and 6-

[1] The results reported below are robust to eliminating the last round bids.

Bid	Independent Variable	Coefficient	Std. Error
highest bid	constant	1.113**	0.027
	experience	0.001	0.027
	period	0.000	0.001
	bankrupt	0.388**	0.092
second bid (difference with highest)	2ndbid	-0.272**	0.040
	2ndbid/experience	-0.230**	0.080
	2ndbid/period	-0.002	0.002
	bankrupt	0.085	0.079

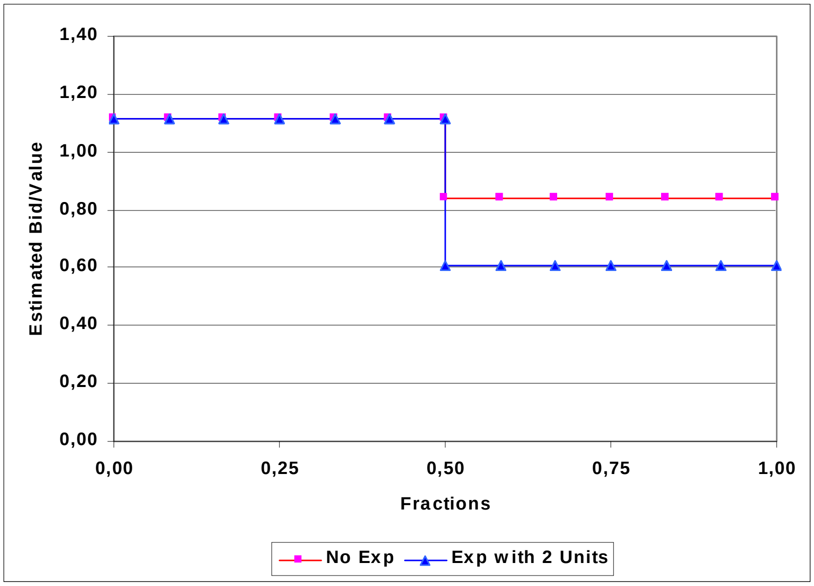
*: $p<0.05$, **: $p<0.01$

Table 7: Demand in 2-unit auctions

unit auctions. In all these cases the results are suggestive of learning due to repeated punishment of overbidders: in the 1- and 2-unit auctions the pattern of overbids by all subjects must nearly always lead to an overpay by those winning the object, and, in case of the 6-unit auctions it was the unusually high initial pattern of bids that, probably, resulted in frequent losses and lead to subjects reducing their bids (the explicit test of this hypothesis is pending). No such dynamics is observed for the other treatments - in fact, subjects in the 4-unit auctions came close to significantly increasing their bids over the course of the auction!

To study demand-reduction (or lack thereof) in multi-unit auctions we separately estimated the demand functions for the 2-, 3-, and 4-unit auctions, using, as before, GLS random effects models. For the 2-unit auction the demand regression is presented in Table 7. As in the previous regression, the independent variable is the bid as a proportion of value. The *experience* variable is a dummy taking value one for bids by experienced subjects. The *period* variable is continuous, there to capture bid dynamics. Finally, the *bankrupt* dummy captures the behavior of those subjects who were forced to stop bidding before the 20th round by early bankruptcy The *2ndbid* variable is the dummy for the second bid, the coefficient on which may be interpreted as the difference between the highest and the second bids (essentially, the demand reduction we are interested in) and the *2ndbid/experience* variable is a dummy for the second bids of experienced subjects, whose coefficient reflects to the difference between the second bids of inexperienced subjects and the same for experienced subjects. Finally, the second bid/time interaction *2ndbid/period* variable captures the dynamic of the second unit bids and *2ndbid/bankrupt* dummy captures the difference in second bids by subjects that would go bankrupt..

What can be observed here is that, whereas the highest bids do reflect the overbidding (also detected in the earlier regression), the second bids are about 27% of value lower, and



prior experience induces a further 23% reduction (both figures are significantly different from zero). Strikingly, there seems to be no intra-session dynamics whatsoever: agents do not learn anything during a session, but seem to sharply reduce their bids when they return for a repeat performance. Another interesting observation is that the subject bankruptcy can be largely explained by their aggressive highest bids; they did reduce demand on the second bid by the amount similar to other subjects (though, of course, their second bids did remain relatively high). The estimated demand for the two-unit auction (for the first period) can be seen in Figure 1:

The estimation of demand for the three-unit auctions is presented in Table 8 and the first-period demand can be seen in Figure 2.

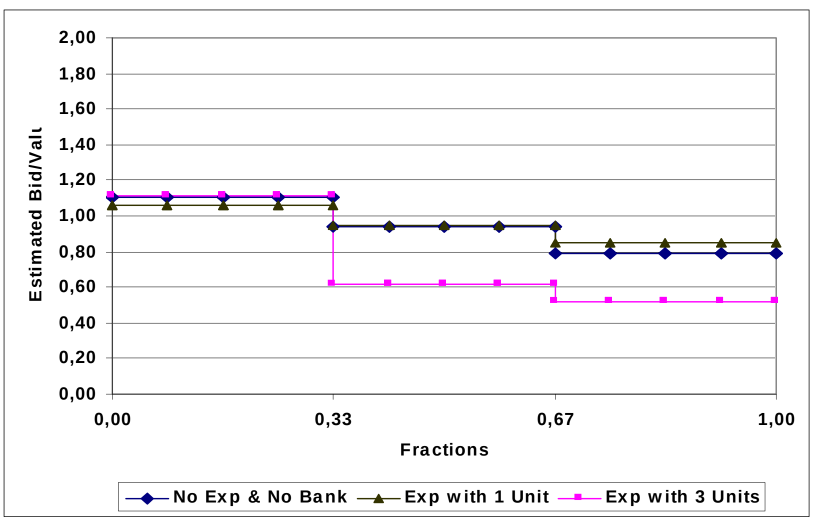
The dummy variables for the lower bids are nested, so that the coefficients can be directly interpreted as demand reduction from the higher bids. This is done by setting the $2ndbid$ dummy equal to 1 both for second and third bids, and setting the $3rdbid$ dummy to 1 for the third bid only; the interaction dummies, such as $2ndbid/bankrupt$, $2ndbid$ experience dummies and the $2ndbid/period$ variable are constructed similarly. Thus, the coefficient on the $3rdbid$ can be interpreted as the average amount by which subjects' third bids are smaller than their second bids.

As in the first regression, it can be immediately seen that agents do substantially overbid on the first unit and that experience, either within a session, or in a prior session does not seem to do anything to eliminate this. There is a slight demand reduction on the

Bid	Independent Variable	Coefficient	Std. Deviation
highest bid	constant	1.103**	0.025
	bankrupt	0.584**	0.121
	3un.experience	0.004	0.042
	1un.experience	-0.050	0.048
	period	0.003	0.002
2nd bid	2nd bid	-0.158**	0.029
(difference w/ highest)	2ndbid/bankrupt	-0.076	0.199
	2ndbid/3un.experience	-0.329**	0.083
	2ndbid/1un.experience	0.059	0.072
	2ndbid/period	-0.007**	0.002
3rd bid	3rd bid	-0.155**	0.019
(difference w/ second)	3rdbid/bankrupt	0.003	0.050
	3rdbid/3un.experience	0.056*	0.024
	3rdbid/1un.experience	0.054	0.045
	3rdbid/period	0.001	0.001

*: $p<0.05$, **: $p<0.01$

Table 8: Demand in 3-unit auctions



Bid	Independent Variable	Coefficient	Std. Deviation
highest bid	constant	1.233**	0.051
	4un.experience	-0.030	0.077
	period	0.0035	0.0023
	bankrupt	0.190	0.107
2nd bid	2nd bid	-0.357**	0.068
(difference w/highest)	2ndbid/experience	-0.257	0.141
	2ndbid/period	0.0011	0.0024
	3rdbid/bankrupt	0.237*	0.100
3rd bid	3rd bid	-0.121**	0.032
(difference w/ second)	3rdbid/experience	-0.046	0.057
	3rdbid/period	-0.0037	0.0020
	3rdbid/bankrupt	-0.074	0.018
4th bid	4th bid	-0.073**	0.0016
(difference w/ third)	4thbid/experience	0.045	0.024
	4thbid/round	-0.0004	0.0012
	4thbid/bankrupt	0.003	0.029

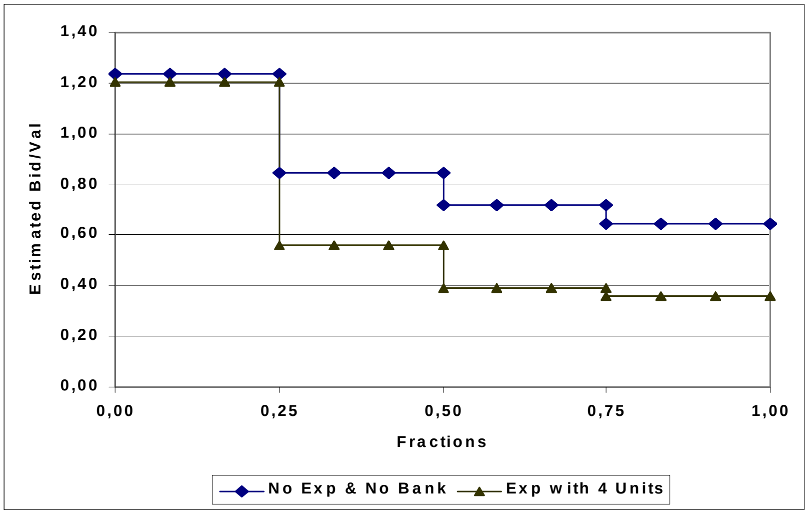
*: $p<0.05$, **: $p<0.01$

Table 9: Demand in 4-unit auctions

second bid by the inexperienced subjects (around 16% of value), but it is prior experience in the same auction format that causes a further 33% decrease. In contrast, there is no statistically significant impact of prior experience in 1-unit auctions. There is, however, some learning going on within session, though not much: on average, over the course of 20 periods second unit bids decrease by about 14%. Considering the further demand reduction, inexperienced subjects reduce their third bid by about 15.5% of value from the second - reduction similar in magnitude to that between the first and second bids. In contrast, subjects with the same experience barely budge: their 10% total decrease is only 1/5 of that between the first and the second bid. This suggests, that, unlike the inexperienced subjects, those with experience realize that in order to get high payoff one has to yield on everything but the highest bid: further bid reduction after that is not likely to affect things.

The results of the demand estimation for the 4-unit auction are presented in Table 9 and the first period demand is plotted in Figure 3:

Bidders in four-unit auctions showed an extremely high tendency to overbid on their highest bid. In fact, they came close to significantly increasing the overbid size during the course of an experimental session, suggesting that high payoffs, recorded in these auctions, reinforced their potentially dangerous mistakes in this respect. Prior experience does not



seem to affect the size of the overbid. Subjects were rarely punished for this, though, due to extremely successful demand reduction beyond the highest bid. In particular, even inexperienced subjects reduced their bids by nearly 36% of value, with experienced bidders making a further 26% reduction (though this coefficient came out insignificant due to very high variance; it would have been significant at 7% level). There was further demand reduction by some 12% of value going to the third bid (unlike the 3-unit case, experienced subjects reduced their demand here by roughly the same proportion as inexperienced), suggesting that the second bids might have actually been slightly elevated by the competition for the fourth unit sold. A further minor reduction in demand on the fourth bid (not really likely to affect profits in this case) occurred only among inexperienced subjects. Of interest is the fact that in their propensity to overbid with their highest bid the eventually bankrupt subjects were not different from the rest. What marked them was their low levels of demand-reduction beyond the highest bid.

In order to test the impact of within-session experience on strategies we regressed individual bid changes on the gains (*gainlag*) and losses (*losslag*) that subjects incurred in the previous period (we did this separately for the 1-,2-,3- and 4-unit treatments and for the highest and second bids, only for bids by subjects that did not go bankrupt within the given session; gains and losses were measured in pesos, but bids were expressed as a proportion of value). The results of the generalized least squares regressions are presented in tables 10 and 11. The striking observation is that in all treatments agents strongly reacted to losses, reducing their bids by five to nine percent of value for each peso lost in the previous period! However, this was counteracted by the subjects' tendency to increase their bids (in most cases by 2% to 5%) whenever they did not incur either gains or losses

Independent Variable	1-unit	2-unit	3-unit	4-unit
const	0.0248**	0.0459**	0.412**	0.0167
std. dev.	(0.0047)	(0.0046)	(0.0054)	(0.0139)
losslag	-0.0565**	-0.0914**	-0.0709**	-0.0961**
std.dev.	(0.0083)	(0.0133)	(0.0074)	(0.0132)
gainlag	0.0005	0.0023	0.0006	0.0067
std.dev.	(0.0011)	(0.0022)	(0.0016)	(0.0035)

**: p<0.01

Table 10: Change of the highest bid (as a proportion of value), given losses and gains in the previous period

Independent Variable	2-unit	3-unit	4-unit
const	0.0336**	0.364**	0.0300**
std. dev.	(0.0083)	(0.0047)	(0.0101)
losslag	-0.0718**	-0.0678**	-0.0686**
std.dev.	(0.0106)	(0.0053)	(0.0116)
gainlag	0.0035	0.0029	0.0009
std.dev.	(0.0022)	(0.0015)	(0.0016)

**: p<0.01

Table 11: Change of the second highest bid (as a proportion of value), given losses and gains in the previous period

in the previous period. As the absence of gains or losses mainly occurred after the rounds in which subjects failed to obtain an object, we conjecture a competitive motivation for increasing the bid. As in the 1-unit treatment actual losses where more frequent than in the multi-unit treatments, the cumulative effect was distinct: over time agents tended to reduce their bids to value in the former, but did not do this, or even increased their bids in the latter. Unlike the losses, gains did not seem to have a distinct effect on bids (possibly encouraging further bid increase in some treatments - this effect is significant at 6% on the highest bids in 4-unit auctions and for the second bids in the three-unit auctions). Interestingly enough, the reaction to past payoffs impacted the highest and second-highest bids in the same fashion. As the "correct" strategy in multi-unit auctions required reducing the second bids to zero, while keeping the highest bids at 1, our findings seem to support some sort of a pure reinforcement learning story (confirming this would require further research).

5 Conclusions

In an experimental no-uncertainty setting with common values we find that uniform-price auctions do not readily lead to low-revenue equilibria even when these are the only ones surviving two rounds of iterated elimination of weakly dominated strategies. Though some agents make an effort to reduce demand, this reduction is, in general, insufficient. This, however, somewhat changes if experienced agents are recalled into the lab, having been able to think through and/or communicate the right equilibrium to each other. The revenue is further increased due to a persistent pattern of overbidding among agents, though this later is largely eliminated among the subjects with experience in participating in single-unit auctions returning to take part in the same. This decrease in overbidding, as the subjects gain experience during the course of the experiment, which seems to be driven by the experience of losses they incur as they play, provides some evidence for reinforcement learning, possibly along the lines of Roth and Erev (1995). In contrast, there does not seem to be much intra-session dynamics concerning lower-bid reduction, with agents changing their second bids in a pattern similar to that of their highest bids. There, the important change seems to be occurring during the time outside the lab.

Our paper is also related to the theoretical and experimental literature on coordination games. In particular, in the three- and four-unit treatments there is a continuum of Pareto-ranked (among bidders) equilibria, which cannot be eliminated by the simple weak dominance argument (as is the case in one- and two-unit auctions). As in earlier studies (see, for instance, Van Huyck et al. 1990), we find that Pareto optimality in the equilibrium set on its own is insufficient to make players converge on that equilibrium. In fact, even when a single iteration of the dominance argument is sufficient to theoretically select such an efficient equilibrium, it is still only occasionally chosen. Somewhat unexpectedly, we find qualitatively similar patterns of demand reduction even when such dominance refinement is impossible (four-unit auctions) and even when demand reduction, though possible in equilibrium, does not generally result in increased payoffs (2-unit auctions). Overall, the issue of what determines equilibrium choice in these auctions requires further exploration.

6 Appendix: The experimental instructions for a three-unit auction *(to be translated).*

Introducción

Su atención por favor. En primer lugar, favor de apagar sus celulares. En un momento comenzaremos con el experimento. Primero iniciaremos nuestra sesión leyendo las instrucciones. Luego llevaremos a cabo unos períodos de práctica y finalmente los períodos a ser jugados por dinero.

Por favor tomen las instrucciones que se encuentran en sus escritorios, junto a su computadora.

" Se procede a leer las instrucciones.

Instrucciones (20/Septiembre/05)

Este es un experimento acerca de la toma de decisiones en subastas. El CONACYT ha provisto fondos para la conducción de este experimento. Las instrucciones son simples y si usted las sigue con cuidado y toma buenas decisiones, podrá ganar un MONTO CONSIDERABLE DE DINERO, que le será PAGADO EN EFECTIVO al final del experimento.

- Procedimiento General

En este experimento usted participará en una subasta como comprador de un bien ficticio. El experimento consta de 25 períodos de compra: 5 períodos de práctica y 20 períodos a ser jugados por dinero. El valor monetario del bien para cada período será un número escogido aleatoriamente entre $20.00 y $100.00 pesos. Cualquier valor dentro de este intervalo tendrá la misma probabilidad de ser escogido. El valor del bien en cada período se determinará de manera independiente de los valores anteriores.

Una vez escogido el valor del bien, éste será dividido en tres fracciones que serán vendidas simultáneamente por separado. Su labor será ofrecer dinero por las distintas fracciones compitiendo con otros compradores. El valor por fracción (VF) del bien es el valor por la unidad completa dividido entre tres. Por ejemplo, si el valor del bien es de $100.00, el valor por fracción será de $33.30. Si el valor del bien es de $20.00, el valor por fracción será de $6.60.

En cada período se formarán grupos de tres compradores. En cada grupo los compradores competirán por las fracciones de un mismo bien. La composición de los miembros de cada grupo cambiará en forma aleatoria, de modo que un mismo grupo estará integrado por compradores distintos al inicio de cada período. Usted nunca sabrá con quién estará participando. El valor del bien será el mismo para todos los integrantes de un grupo, y podrá ser distinto para cada grupo.

- Procedimiento Específico

Al inicio de un período cada comprador escribirá y enviará una oferta por cada fracción del bien. Las tres ofertas más altas ganarán el valor por fracción del bien. Por lo tanto, cada comprador podrá obtener tres, dos, una o ninguna fracción del bien. En caso de que se produzca un empate en las ofertas, la computadora escogerá aleatoriamente las tres ofertas ganadoras. Nadie podrá ofrecer por cada fracción del bien menos de $0 ni más de $33.30 pesos. Asimismo, no podrá ofrecer más por la segunda fracción que por la primera fracción, ni más por la tercera que por la segunda.

El precio a pagar por fracción será el monto de la cuarta oferta más alta. Por lo tanto, la ganancia (o pérdida) monetaria por fracción de un ganador será el valor por fracción menos el precio a pagar por fracción. Las ganancias de los demás compradores serán de cero. Las ganancias totales de cada comprador serán la suma de las ganancias (o pérdidas) monetarias por las fracciones obtenidas.

Comprador	Fracciones	Ofertas	Ganadoras	Precio	Ganancia
C1	F1	20.55	**		VF- 13.40
	F2	15.50	**		VF- 13.40
	F3	10.00			0
C2	F1	16.50	**		VF- 13.40
	F2	12.40			0
	F3	12.40			0
C3	F1	13.40		*	0
	F2	12.50			0
	F3	10.00			0

Al final de cada ronda, los integrantes de cada grupo conocerán las ofertas ganadoras, el precio pagado, y sus ganancias (o pérdidas) individuales. Después se procederá a la siguiente ronda.

Ejemplo

A manera de ejemplo, veamos el siguiente cuadro de ofertas realizadas por un grupo de compradores: Los compradores C1, C2 y C3 han realizado una oferta por cada una de las tres fracciones del bien. Las tres ofertas más altas del grupo son las indicadas con doble asterisco: 20.55-C1, 16.50-C2, 15.50-C1. Los ganadores de las tres fracciones del bien pagarán la cuarta oferta más alta: 13.40, la cual se señala con un solo asterisco. La ganancia (o pérdida) por cada fracción se muestra en la última columna, donde al valor por fracción se le resta el precio a ser pagado.

¿Tienen alguna pregunta respecto al ejemplo?

Ejercicio

A manera de ejercicio y para clarificar dudas, indique con dobles asteriscos las tres ofertas ganadoras y con un solo asterisco el precio que pagarían por cada una de las fracciones. Asumiendo que el valor por fracción es de VF, indique en la última columna ¿cuánto sería la ganancia de cada comprador por cada unidad?

¿Tienen alguna pregunta respecto al ejercicio?

- Saldo Inicial, Saldo Acumulado y Saldo Mínimo

Cada comprador comenzará el experimento con un saldo inicial de $60 pesos. Las ganancias (o pérdidas) totales de cada ronda serán sumadas (o restadas) al saldo acumulado del período anterior.

Si el saldo de un comprador para cualquier período es menor a $20 pesos, no se le permitirá seguir participando. Se le pagará su saldo final acumulado y deberá retirarse. En caso de tener saldo negativo, no recibirá pago alguno.

En caso de no poderse formar todos los grupos debido a la salida de algunos de los participantes, la computadora formará aleatoriamente tantos grupos como sea posible. Los participantes que no puedan ser incluidos en un grupo para un período determinado

Comprador	Fracciones	Ofertas	Ganadoras	Precio	Ganancia
C1	F1	20.65			0
	F2	18.50			0
	F3	15.00			0
C2	F1	26.16	**		VF- 22.00
	F2	22.10	**		VF- 22.00
	F3	22.00		*	0
C3	F1	30.40	**		VF- 22.00
	F2	20.50			0
	F3	11.00			0

deberán esperar a las siguientes rondas para poder participar nuevamente como compradores.

- Procedimiento de Pago

Su saldo acumulado al final de la última ronda le será pagado en efectivo al final del experimento.

¿Tienen alguna pregunta respecto a las instrucciones?

Próximos Pasos (Leído por el investigador luego de leer las instrucciones)

Conexión con el Servidor

Pasemos ahora a iniciar el experimento. Cada participante deberá iniciar su conexión con el servidor usando el siguiente procedimiento: Introduzca en la casilla de contraseña y confirmación los tres números escritos en la parte superior de sus formatos de REGISTROS DE IDENTIFICACIÓN que se encuentran al lado de su computadora. Luego presione la casilla de enviar.

Si su conexión resulta exitosa, por favor presione la casilla de aceptar.

" Completados los registros, presionar fin de registro.

Lectura de Pantalla

A continuación revisaremos la información que por ahora aparece en su pantalla. Cuando iniciemos la sesión, en la parte superior izquierda encontraremos el PERIODO DE LA SUBASTA. Asimismo, encontraremos el TAMAÑO DE CADA GRUPO DE COMPRADORES (que en nuestro caso es de tres compradores), y el TIPO DE SUBASTA en el cual usted estará participando (que en nuestro caso es una subasta de precio uniforme).

La computadora les ha asignado a cada uno un NÚMERO DE USUARIO que se encuentra en la parte superior derecha de la pantalla. Por favor anote este número debajo de los tres números que inicialmente usted introdujo en la computadora. Estas cifras son personales y servirán como una forma de identificarlos manteniendo su anonimidad durante el experimento.

En la parte central de la pantalla se encuentra el monto de su SALDO ACTUAL. Su saldo inicial es de $60 pesos. Hablaremos de las otras secciones más adelante.

Rondas de Práctica

Llevaremos ahora a cabo 5 rondas de prácticas. El objetivo primordial de estas rondas de prácticas es que usted se familiarice con el software que hemos diseñado para que introduzca sus ofertas durante la subasta. Si tiene alguna pregunta durante la práctica, por favor levante la mano y trataré de responderla.

Generar Período 1

Damos ahora inicio al 1er período de práctica.

" Presionar: Iniciar Período.

En sus computadoras se acaba de abrir una nueva pantalla con una PLANTILLA GRÁFICA en el lado izquierdo e INFORMACIÓN NUMÉRICA dispuesta en el lado derecho.

Voy a explicarles el uso de la PLANTILLA GRÁFICA. Las barras sombreadas que se encuentran en el lado inferior y derecho de la plantilla gráfica son las barras de desplazamiento. Para desplazarse arrastre la barra hacia arriba o hacia abajo para moverse a lo largo del eje vertical o hacia el lado derecho o izquierdo para moverse a lo largo del eje horizontal. Por favor practique con las barras.

El eje vertical izquierdo de la plantilla indica el monto de dinero que usted ofrecería por cada fracción del bien a ser subastado. El monto que usted puede ofrecer va desde cero hasta $33.30 pesos. El eje horizontal inferior indica el número de fracciones del bien que están siendo subastadas (que en nuestro caso son de tres fracciones).

A continuación, coloque por favor el mouse en la coordenada de precio de 6.00 pesos y cantidad de 0. Estas coordenadas deben ahora aparecer junto al cursor. Si desplaza lentamente el cursor hacia la derecha al nivel de la coordenada de precio de 6.00 pesos, la segunda coordenada cambiará primero a 1, luego a 2 y finalmente a 3. Esto esta indicando el número de la fracción del bien.

Voy ahora a explicarles la INFORMACIÓN NUMÉRICA que aparece en el lado derecho de la pantalla. En la primera casilla se muestran las COORDENADAS dentro del gráfico. Si coloca el cursor en la coordenada de precio de 6.00 pesos y cantidad 0, en la casilla de COORDENADAS aparecerá los valores 6.00 coma 0.

Inmediatamente debajo de la casilla de COORDENADAS se encuentra la casilla correspondiente a los INTERVALOS DE SEÑAL. La información que se muestra en estas dos casillas no es relevante para nuestro experimento.

A continuación se encuentra la INFORMACIÓN NUMÉRICA denominada SEÑAL COMPLETA. Las casillas que se encuentran bajo esta denominación se refieren al valor por la unidad completa del bien, expresado en pesos por unidad para la primera casilla o por fracción para la segunda casilla. El valor de cada fracción del bien es el valor de la primera casilla dividido entre 3.

Finalmente, nos encontramos con la INFORMACIÓN NUMÉRICA referida a los INTERVALOS DE VALOR. En estas casillas se indica el intervalo de donde fueron generadas las valoraciones de la unidad completa del bien y por fracción. Así el valor por unidad completa del bien está entre 20.00 y 100.00 pesos, mientras que el valor por fracción está entre 6.60 y 33.30 pesos. Estos valores no cambiarán durante el experimento.

Voy ahora a explicarles cómo proceder a introducir sus ofertas. Es muy sencillo. Para introducir una oferta por la primera fracción del bien deberá hacer un primer CLICK al nivel del precio que usted desea ofrecer en el lado izquierdo de la PLANTILLA GRÁFICA. A manera de práctica, por favor proceda a introducir una oferta al precio de 20.00. Luego de hacer un CLICK deberá aparecer una cruz azul en el lado izquierdo de su pantalla.

Hora deberá mover el mouse hacia la derecha hasta que las coordenadas de fracciones indiquen el número de fracciones que desea solicitar a este precio. Este número podrá ser de 1, 2 o 3. Una vez elegido el número de fracciones, deberá proceder a realizar un nuevo CLICK.

Supongamos que deseamos ofrecer 20.00 pesos por las dos primeras fracciones. Deberemos entonces hacer el segundo clic en la coordenada 20.00 coma 2. Aparecerá entonces una línea azul, indicando que usted está haciendo una oferta de 20 por las dos primeras fracciones del bien.

Supongamos, en cambio, que usted deseaba realmente ofrecer 20.00 pesos sólo por la primera fracción. Deberemos entonces deshacer esta oferta. Para deshacer esta oferta deberá hacer CLICK en el recuadro de DESHACER que se encuentra en el lado derecho de la pantalla. Por favor proceda a deshacer la oferta. Ahora proceda a introducir la oferta de 20.00 por la primera fracción haciendo CLICK en la coordenada 20.00 coma 1.

Para realizar su oferta por la segunda fracción, deberá mover el mouse hacia abajo hasta el precio que desea ofrecer y realizar un nuevo clic. A manera de práctica, proceda a realizar su oferta por la segunda fracción moviendo el mouse hasta la coordenada de precio de 10.00 coma 1 y luego hacia la derecha hasta la coordenada de precio de 10.00 coma 2, realizando un nuevo CLICK.

Finalmente, para realizar su oferta por la tercera unidad, hacer el mismo procedimiento anterior. A manera de práctica proceda a realizar su oferta por la tercera fracción moviendo el mouse hasta la coordenada de precio de 0.00 coma 2 y luego hacia la derecha y realizando un nuevo clic.

En este ejemplo usted estaría haciendo una oferta de 20 pesos por la primera fracción, de 10 pesos por la segunda y de 0 pesos por la tercera.

Si desea enviar su oferta, simplemente haga CLICK en el recuadro ENVIAR. La computadora le solicitará que confirme o no su oferta. Si confirma, se procederá el envío de su oferta. Si decide no confirmar, la computadora volverá a la pantalla anterior con el objeto de que modifique su oferta si así lo desea.

Por favor, no confirme, deshaga las ofertas y vuelva nuevamente a realizar una nueva oferta por cada una de las fracciones.

Una vez que envíen sus ofertas, deberán esperar a que todas las ofertas hayan sido enviadas para saber el resultado del período que estamos llevando a cabo. Mientras espera a que los otros participantes finalicen, lo que se muestra en pantalla no indica el resultado de la subasta.

¿Tienen alguna pregunta?

Lectura de Pantalla de Resultados

Ahora hemos vuelto a la pantalla de resultados. Aquí usted podrá ver la información correspondiente al valor del objeto expresado en pesos por unidad y por fracción, la señal recibida (que para ustedes es la misma que el valor del objeto), la cuarta mejor oferta o primera oferta perdedora.

Asimismo se le informa el monto de las propuestas ganadoras. En particular, se informa el precio ofrecido por fracción y la unidad asignada.

Finalmente se informa sus propuestas personales, si obtuvo o no algunas de las fracciones y cuál fue su ganancia. Esta ganancia (o pérdida) es sumada a su saldo inicial para convertirse ahora en su saldo actual. Vea el recuadro central para verificarlo.

¿Tienen alguna pregunta?

Generar Período 2

Procedamos ahora al 2do. período de práctica. (Presionar: Iniciar Período) Procedan a tomar sus decisiones.

¿Tienen alguna pregunta?

Generar Período 3

Procedamos ahora al 3er. período de práctica. (Presionar: Iniciar Período) Procedan a tomar sus decisiones.

¿Tienen alguna pregunta?

Generar Período 4

Procedamos ahora al 4to. período de práctica. (Presionar: Iniciar Período) Procedan a tomar sus decisiones.

¿Tienen alguna pregunta?

Generar Período 5

Procedamos ahora al 5to. período de práctica. (Presionar: Iniciar Período) Procedan a tomar sus decisiones.

¿Tienen alguna pregunta?

Períodos Reales o Jugados por Dinero

Ahora procederemos a llevar a cabo los 20 períodos a ser jugados por dinero.

" Revisar todas las pantallas.

Luego que el experimento comience, no le está permitido hablar o comunicarse con otros participantes. De lo contrario, me veré forzado a excluirlo del experimento. Favor concéntrense en su pantalla de computadora. Si tiene alguna pregunta, por favor levante su mano y uno de nosotros se acercará y tratará de responderla.

Generar Período 1 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 2 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 3 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 4 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 5 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 6 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 7 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 8 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 9 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 10 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 11 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 12 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 13 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 14 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 15 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 16 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 17 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 18 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 19 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Generar Período 20 (Presionar: Inicio de Período)

Procedan a tomar sus decisiones.

Pago Final

Su pago es el que aparece en el saldo de su pantalla.

Por favor, manténganse en sus puestos. Uno de nosotros pasará a entregarles un cuestionario final y su recibo de pago para ser llenado por ustedes.

Luego se les llamará para que salgan a recibir su pago. Por favor, pasen a dejar el cuestionario y el lápiz.

Muchas gracias por su participación!

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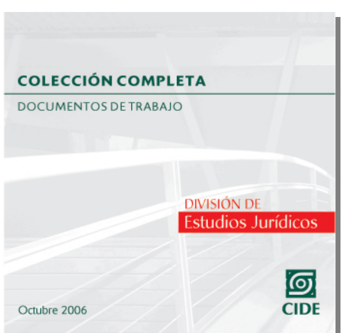

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