Using feedback to mitigate coordination and threshold problems in iterative combinatorial auctions

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Appendix (available online via http://link.springer.com)

Supplementary materials to "Using feedback to mitigate coordination and threshold problems in combinatorial auctions"

1 Auction efficiency boxplots

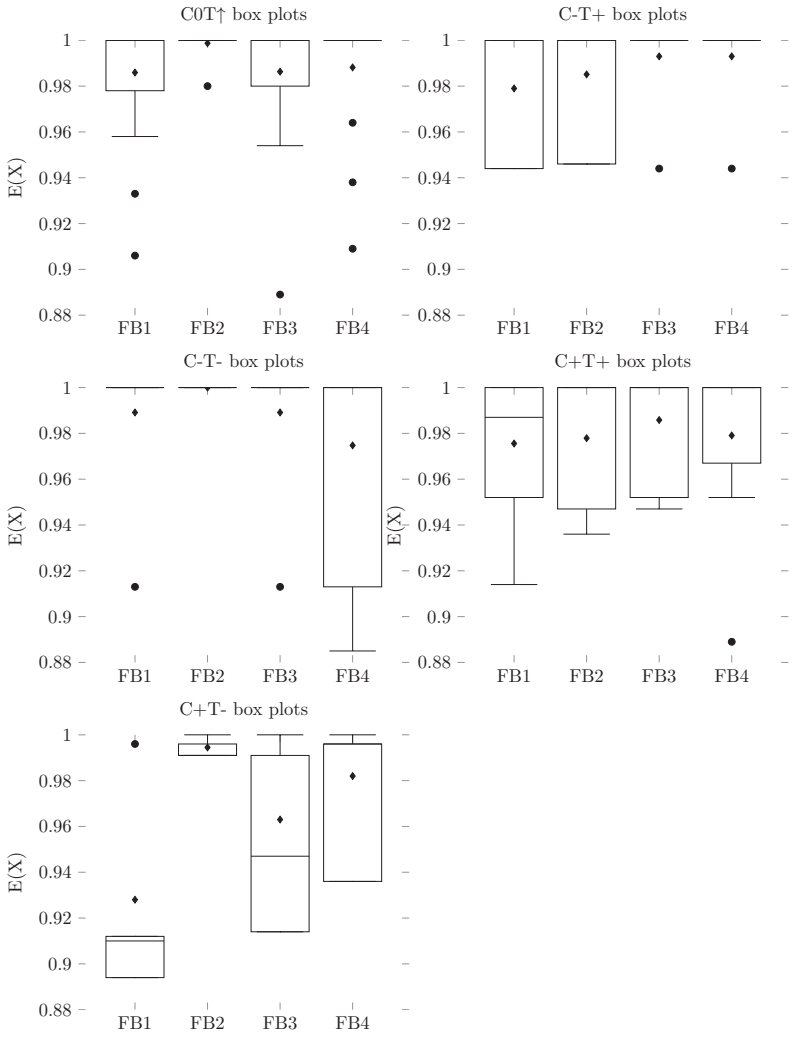

Figure 1: Boxplots of per feedback level, for each of the 5 auction settings.

2 Experiment instructions

Introduction and goals of the study

This is an experiment in the economics of decision making. The goal of this research is to experimentally study decision behavior in strategic environments. The purpose is to apply the gained insights to better design allocation mechanisms, improving social efficiency.

The instructions are simple, and if you follow them carefully, you can, depending on your decisions, earn a considerable amount of money. This amount will be paid to you in cash later; you will be informed of the details by e-mail. It is very important that you read these instructions with care.

Procedure

The procedure of this experimental session is as follows:

1. Reading of the instructions
2. Filling in the test questions
3. Participating in a series of auctions
4. Filling in a questionnaire

The auction environment

In this experiment, we will create auction environments consisting of 9 participants; yourself along with 8 other participants. You will act as participants in a sequence of auctions. In each auction 6 items are put up for sale simultaneously, and participants may submit bids on any *combination* of items they want (also called "*package*").

There is no relation between consecutive auctions. In other words, each auction will be completely independent of the previous auction(s).

The values

Each participant will be assigned private values for all possible combinations of items. These values represent the value of the (combination of) item(s) to you. By clicking on a package, your private value for this selection will appear on the screen (see screen shot). You are not to reveal this information to any other participant. It is your own private information.

It is possible the value of a package of items is greater than the sum of the values of the items in the package separately. However, this can only occur between adjacent items.

For example, suppose the value of item 1, on its own, is 20. The value of item 2, on its own, is 40. It is possible that the value for the package {1,2} is equal to 100. Here,

the value of the package (100) is larger than the sum of the values of the individual items (20+40=60).

Bids:

Each participant can bid on any combination of items. Participants are allowed to place multiple bids every round. You are free to bid whatever you think will bring you the most earnings, as long as this amount does not exceed your private valuation. There is a minimum bid increment of 1 in place. For example, you may bid a price of 26, but not of 26.3.

Once you press the 'Enter Bid'-button, the bid is finalized; it can no longer be changed or retracted.

Round structure:

Every auction consists of successive rounds in which participants may place bids. A round ends when all bidders indicate that they are done entering bids for that round, or when the time limit (in seconds) is reached. Information on the round number and the remaining time can be found at the top of the bidding screen.

Determination of winning bids:

The winning bids are selected in such a way that the total revenue (sum of the prices of the winning bids) for the round is maximized, while making sure every item is sold at most once. Note that this means one participant could possibly win more than one bid. In case of ties among the highest bids we will randomly pick a winner of the item.

Closing rule:

The auction closes after three consecutive rounds in which the total auction revenue does not increase. Only bids that are winning after the auction has closed are used to calculate auction earnings.

Bidder earnings:

Participant earnings depend on the results of the auctions. Winning any (combination of) item(s) at a price below the private value of those items, results in a profit. The larger this difference, the bigger the profit. After the auctions are completed, the bidder earnings will be calculated in detail by the experimenter.

The interface:

Screen shots of the bidder interface, along extra information, are given in the next 3 pages. Please examine them carefully. The first two images are from during a bidding round: here bids can entered. The third image is from after a bidding round: it displays the results of a bidding round.

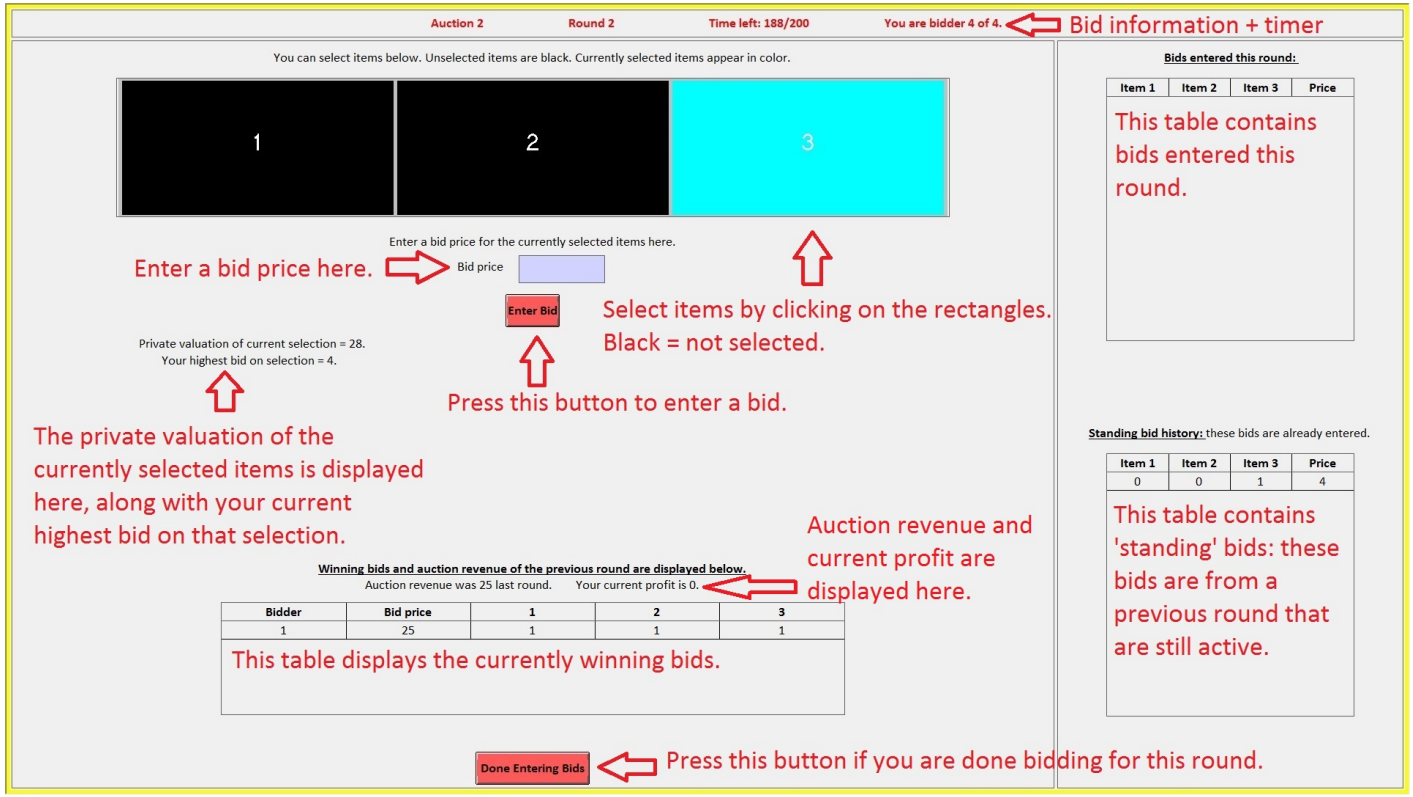

Figure 2: GUI: the bid interface.

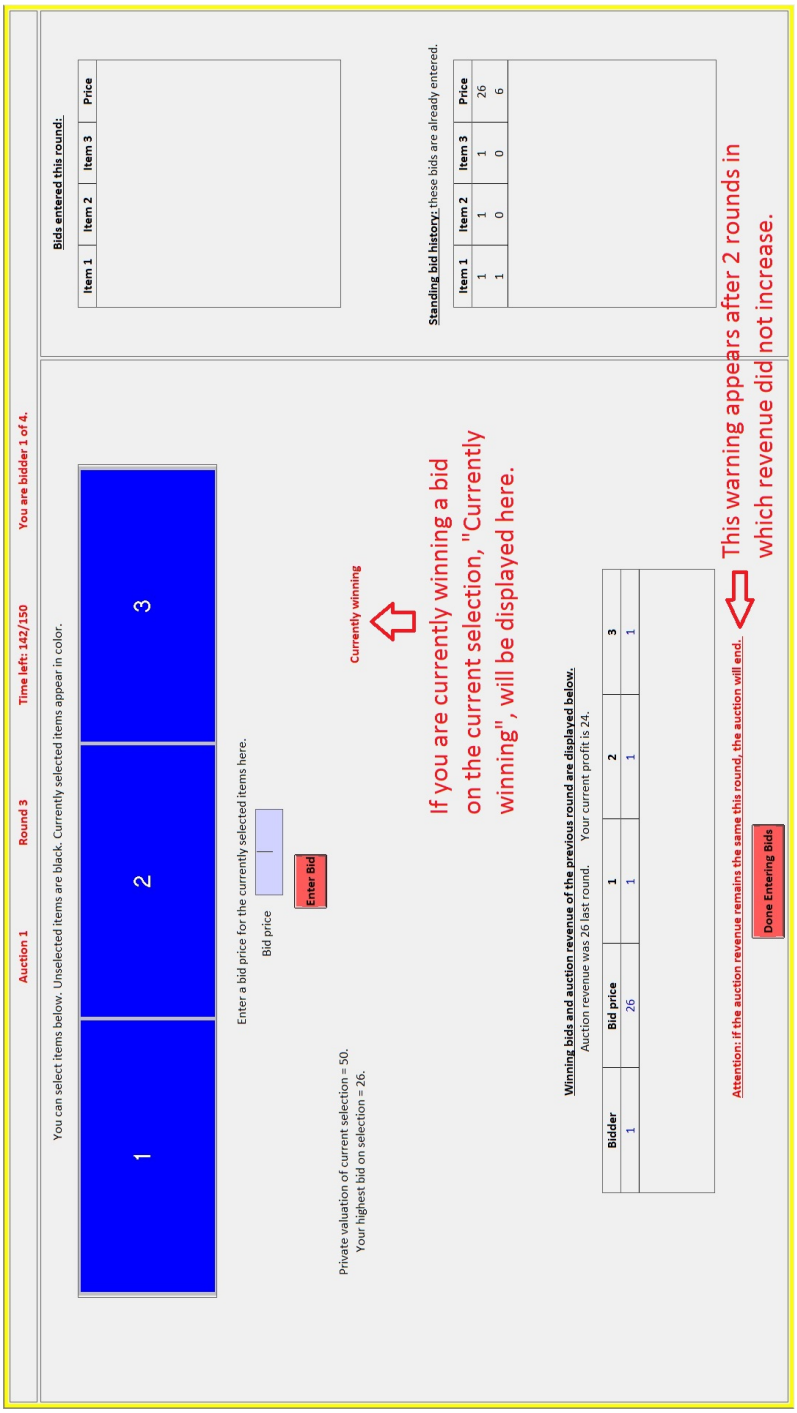

Figure 3: GUI: when bidders try to bid on a package they are currently (provisionally) winning.

Figure 4: GUI: display of (provisional) winning bids after a round has finished.

Test questions:

After reading the instructions, please fill in the questions below. The experimenter will go over the answers to the test questions before starting the auctions.

- Suppose your valuation for some package of items is equal to 8. What is the maximum price you can bid on this set of items?

  . . . (Answer: 8)

- Suppose the revenue of round 4 was 30. Will there be a next round if the revenue of round 5 will be 30?

  . . . (Answer: Yes)

- Suppose the revenue of round 4 was 30. The revenue of round 5 was 30. Will there be a next round if the revenue of round 6 will be 30?

  . . . (Answer: No)

- Suppose you enter a bid on the package {1,2}. Are you allowed to also enter a bid on the package {2,3} in the same round?

  . . . (Answer: Yes)

- Suppose you did not enter a bid on the package {1,2} in round 1. Are you allowed to enter a bid on the package {1,2} in any following round?

  . . . (Answer: Yes)

- Suppose you enter a bid on the package {2,3}. Are you allowed to enter another bid on the package {2,3} in the same round?

  . . . (Answer: Yes)

- After a round, is it possible that you win multiple bids?

  . . . (Answer: Yes)

3 Feedback explanations

This section contains the explanation used in the laboratory experiments for feedback level 4 (FB4).

Winning levels

After round 1, every unique combination of selected items will have its own winning level. The winning level represents the price required for a bid to win, given that all other bids remain the same. Note: even if you are provisionally winning a bid, you will still get winning level feedback.

Example 1: you select items 1 and 2 in round 5. The displayed winning level is 50. If you bid 50 on items 1 and 2, and nobody else makes a bid this round, you are sure to win items 1 and 2 for 50.

Example 2: you select items 2 and 3 in round 4. The displayed winning level is 45. If you bid 40 on items 2 and 3, and nobody else makes a bid this round, your bid of 40 on items 2 and 3 will not become winning.

Example 3: you select items 1, 2, and 3 in round 6. The displayed winning level is 100. Other bidders entered bids in round 6. Even if you bid more than 100 on items 1, 2, and 3, there is no guarantee your bid will become winning.

Example 4: in round 3, you have a provisional winning bid on item 1 with a price of 75. In round 4, if you select item 1, the displayed winning level will be 75.

Deadness levels

After round 1, every unique combination of selected items will have its own deadness level. The deadness level represents the minimum price required for a bid to ever be able to become winning, given that all other bids remain the same.

Example 1: you select items 1 and 2 in round 5. The displayed deadness level is 50. If you bid 50 on items 1 and 2, and nobody else makes a bid this round, your bid could still become winning in a future round.

Example 2: you select items 2 and 3 in round 4. The displayed deadness level is 45. If you bid 40 on items 2 and 3, your bid of 40 on items 2 and 3 will not become winning.

Example 3: you select items 1, 2, and 3 in round 6. The displayed deadness level is 100. Even if you bid more than 100 on items 1, 2, and 3, there is no guarantee your bid will ever become winning.

Coalitional feedback with suggestion

Coalitional feedback can appear if there are multiple bids that can become winning together, thus beating the currently winning bids, given that all bids outside of the coalition remain the same. Coalitional feedback is, when available, given in the following format:

"If x bids, including this one, are collectively raised by y, these x bids become winning. We suggest you bid z."

The word collectively is important here: all x bids have to increase their current bids by a total of y to beat the currently winning allocation. If every bid is increased to z, as suggested, those bids become winning together.

All bids in a coalition receive a similar message.

Note that it is possible to receive multiple such messages for a single bid.

The interface

A screen shot of the bidder interface and where the feedback is located is given on the following page.

Figure 5: GUI: FB4 message for a bid.