CSE 316A: Homework 3

Due on November 9, 2015
Total: 100 points + 10 bonus points

Notes

• There are 2 problems on 3 pages below, worth a total of 110 points. However, this homework will be graded out of 100 points, and any additional points you gain above the 100 points will count towards your overall homework score (40% of your total score for the course).

• Homework (typed or hand-written) must be handed in to me individually at the beginning of lecture on Monday, November 9, between 2:30 pm and 2:45 pm.

• You must write / type all your answers on your own. This assignment requires programming; you must write your own code and turn it in along with your write-up.

• Before you prepare your submission, you are free to discuss any problem with other students in this course and / or use resources other than the textbook and lecture notes. But you must clearly mention the students with whom you discussed the homework as well as any outside resources you used on your submission.

• Please review the academic integrity policy and grade appeal policy specified in the official course syllabus at http://www.cse.wustl.edu/~mithunchakraborty/SyllabusCSE316A.pdf.

• My office hours are Tuesdays 2:00 pm to 4:00 pm in Bryan 503.

Problems

1. For this problem, you will simulate the two auction formats we discussed in class (first price sealed bid auction and second price sealed bid auction). This problem requires programming, and you must attach your code.

As usual, we will assume that there is one seller with a single indivisible copy of an item that she values at 0, and 5 bidders (potential buyers), labeled 1 through 5, with random private valuations (intrinsic values) for the item. Also note that you must round every real number to two decimal places.

(a) Second price sealed bid auction: For this auction format, assume that each bidder plays her dominant strategy of bidding truthfully (i.e. announcing her intrinsic value as her bid); after all bids are submitted, the highest bidder wins, and buys the item from the seller at a price equal to the second highest bid (a tie is broken in favor of the bidder
(a) Each bidder’s private valuation is generated independently from a continuous uniform distribution over \([0, 10]\).

ii. Each bidder submits her bid to the auctioneer.

iii. The winner is decided, and the \textit{total trader surplus} and \textit{seller revenue} resulting from the sale of the item is evaluated.

Perform 500 instances of the above simulation, and report the average total trader surplus and average seller revenue over these instances. (20 points)

(b) \textbf{First price sealed bid auction:} For this auction format, the highest bidder wins (ties being broken in favor of the bidder with the lowest numerical label) as usual, and pays the seller a price equal to her own bid in exchange for the item. Recall that truthful bidding is not a dominant strategy for this format; we will assume that each bidder “shades her bid” or “underbids” by a certain percentage, and study the effect of the amount of this shading on (expected) trader surplus and seller revenue.

For this auction format, you will perform 5 sets of 500 simulations each; in each set, all bidders will bid the same percentage, say \(x\%\), of their valuations, and the values of \(x\) for the successive simulations are 90, 80, 70, 60, and 50 respectively.\(^1\) Other details of the simulation are similar to those (steps i through iii) in part (a).

Perform these five sets of simulations, and report the average total trader surplus and average seller revenue for each set (in the form of a table). (40 points)

(c) Discuss your observations. (10 bonus points)

2. \textbf{(Textbook Chapter 11 Exercise 7, slightly modified)} Consider a trading network in which there are two buyers (B1 and B2), two sellers (S1 and S2), and two traders (T1 and T2). The sellers each have one unit of the object and value it at 0; the buyers are not endowed with the object, but they each want one unit and attach a value of 1 to one unit. Seller S1 and Buyer B1 can trade only with trader T1; seller S2 and Buyer B2 can each trade with either trader.

(a) Draw the labeled trading network, with edges representing pairs of people who are able to trade with each other. (10 points)

(b) Consider the following prices and flow of goods:

\begin{itemize}
  \item T1’s bid price to Seller S1 is 0, his bid price to Seller S2 is 1/2, his ask price to Buyer B1 is 1, and his ask price to Buyer B2 is 1/2.
  \item T2’s bid price to Seller S2 is 1/2 and his ask price to Buyer B2 is 1/2.
  \item One unit of the good flows from Seller S1 to Buyer B1 through Trader T1; and, one unit of the good flows from Seller S2 to Buyer B2 through trader T2.
\end{itemize}

\(^1\)For example, in the second set of simulations, a bidder whose intrinsic value is 5.84 submits a bid of \((0.8 \times 5.84) = 4.67\) (rounded).
Do these prices and this flow of goods describe an equilibrium of the trading game? If you think that the answer is No, then briefly describe how someone should deviate. If you think that the answer is Yes, then briefly explain why the answer is Yes. (15 points)

(c) Suppose now that we add a third trader (T3) who can trade with Seller S1 and Buyer B1. This trader cannot trade with the other seller or buyer, and the rest of the trading network remains unchanged. Consider the following prices and flow of goods:

- The prices on the old edges are unchanged from those in part (b).
- The prices on the new edges are: a bid of 1/2 to Seller S1 by Trader T3 and an ask of 1/2 to Buyer B1 by Trader T3.
- The flow of goods is the same as in part (b).

Do these prices and this flow of goods describe an equilibrium of the trading game? If you think that the answer is No, then briefly describe how someone should deviate. If you think that the answer is Yes, then briefly explain why the answer is Yes. (15 points)