CS 136 Pset 6

Sponsored Search Auctions

November 2, 2018

Problem 1.
Our team name is armlb1.

Problem 2. See code.

Problem 3.

(a) `python2 auction.py --perms 1 --iters 200 --seed 2 Truthful,5`

`python2 auction.py --perms 1 --iters 200 --seed 2 Armlb1bb,5`

	Truthful ($)	Balanced Bidding ($)
Agent 1	372.85	825.56
Agent 2	317.86	748.99
Agent 3	339.20	789.48
Agent 4	368.27	811.93
Agent 5	329.75	721.96

We see that the average utility of truthful agents is $345.59 while the average utiltiy of balanced-bidding agents is $779.58. The average utility of truthful agents is much lower since they bid their true values; on the other hand, balanced-bidding agents tend to bid lower than their true values. (In the case where an agent is going for the top spot or the price the agent would pay $t_{j^*} \geq v_i$, then the agent would bid his true value.) This strategy bumps up the average utility for balanced-bidding agents.

(b) `python2 auction.py --perms 10 --iters 200 --seed 2 Truthful,4 Armlb1bb,1`

`python2 auction.py --perms 10 --iters 200 --seed 2 Armlb1bb,4 Truthful,1`

	4 Truthful, 1 BB ($)	4 BB, 1 Truthful ($)
Agent 1	385.36	740.86
Agent 2	410.85	735.69
Agent 3	406.95	719.04
Agent 4	398.58	702.81
Agent 5	559.03 (BB)	782.89 (Truthful)

We see that in the case of 4 Truthful agents and 1 Balanced-Bidding agent, the average utility of the Truthful agents is slightly higher than in the case of 5 Truthful agents. This is likely due to the fact that the 1 BB agent submits slightly lower bids while the bids of the Truthful agents are still fixed. However, the balanced bidding agent still has the highest utility.

In the case of 4 BB agents and 1 Truthful agent, the average utility of the BB agents falls slightly. However, the 1 Truthful agent still has the highest utility out of the 5 agents. The Truthful agent likely benefits from the lower bids of the BB agents.

We do note that in the 4 BB, 1 Truthful agent case, the average utility of the 4 BB agents is only slightly lower than the utility of the 1 Truthful agent (by around $\$50 - \$60$). We conclude that in a group of truthful agents, the better strategy is to adopt a balanced-bidding strategy, while in a group of BB agents, the better strategy is to adopt a truthful strategy. In the case that we have no information about the behavior of other agents, the balanced-bidding strategy seems to perform better on average than the truthful strategy.

Problem 4. (a) Done in the code!

(b) We run the simulation using the following command:

```
python2 auction.py --perms 1 --iters 200 --reserve 0 --seed 2 --mech=gsp
 Armlb1bb,5
```

We see that the revenue under GSP with no reserve price is \$4029.39. As the reserve-price increases, the auctioneer's revenue generally increases. We say the revenue-optimal reserve price is \$90 since by increasing the reserve price over \$90 the auctioneer's revenue starts decreasing. At the reserve price of \$90, the revenue is just slightly over \$5000.

Reserve Price (\$)	Revenue (\$)
0	4029.39
10	4102.69
20	4225.22
30	4480.56
40	4507.59
50	4814.96
60	4977.92
70	4854.83
80	4962.75
90	5163.52
100	4773.55
110	4653.42

(c) We see that the revenue under VCG with no reserve price is \$4231.64. As the reserve-price increases, the auctioneer's revenue generally increases until the reserve price hits

$85. We say the revenue-optimal reserve price is $85 since by increasing the reserve price over $85 the auctioneer's revenue starts decreasing. At this reserve price, the revenue is just slightly over $5205.05.

Reserve Price ($)	Revenue ($)
0	4231.64
10	4231.64
20	4231.64
30	4270.93
40	4446.27
50	4634.40
60	4661.68
70	4897.41
80	5115.31
85	5205.05
90	5041.38
100	4997.27
110	5047.89

(d) The average daily revenue from switching from GSP to VCG is $3706.36. This is less than both the daily average from sticking with either GSP or VCG. This is expected since there is a short-term effect from switching since the prices in VCG are lower than the prices in GSP, and agents need time to adjust their bids to the switch in mechanism.

(e) Throughout these exercises, we were able to confirm many of the theories we had about GSP and VCG mechanisms for advertisement auctions. Firstly, comparing part b) with part c), we can see that the revenue generated from a Balanced Bidder in a GSP auction is, in general, very similar to the revenue generated by a Truthful bidder in a VCG auction. Assuming that bidders indeed tend towards a balanced bidding scheme, this confirms our theory that VCG and GSP yield the same revenue when agents are balanced and envy-free. Additionally, we were able to see that revenue generally increased with higher reserve prices, as we would expect. However, this only holds up to a reserve price of around 80 to 90 dollars at which point the revenue decreases or stagnates. Finally, we were able to verify the decrease in revenue from switching from GSP to VCG. Since the bidders remain in a balanced bidding scheme and don't convert to truthful bidding, our mechanism actually has severely decreased revenue from this switch. This highlights the practical concerns that Google and other search engines might have about switching from a GSP bidding scheme to a VCG bidding scheme.

Problem 5.

(a) We name our bot *Scrooge Bot* after the protagonist in Charles Dickens' novella *A Christmas Carol*. The initial bid is the same as the balanced bidder bot, which we

found seems to be relatively good from empirical testing. Afterwards, our bot is similar to the balanced bidder in that it decides which position it wants based on the bids and clicks from the previous round of the auction. However, instead of trying to find a balanced bid, *Scrooge Bot* simply bids a penny above the minimum bid needed to acquire the position. If the minimum bid is above *Scrooge Bot's* value, it will just bid its true value.

The success of this bot relies on a set of assumptions that we hope to be true in general throughout the class. Firstly, we assume that many bots in the class will be similar to the Balanced Bidder bot since that is the foundation from which our budget bots are built. Additionally, given the budget constraint, we hope that other bots will not overbid to steal higher positions since our bot is especially prone to having its position stolen.

(b) Done.