Advanced Algorithms Lab: Assignment 3

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1 Part A

For $T = 1$, assuming we overbid and win a slot then:
- If the second highest bid (of the bids that are less than ours) is more than our value then the revenue is smaller than the payment and our budget will then decrease. Therefore, it is better to bid nothing and save our budget.
- And if the second highest bid is less than our value, then our result does not get better by overbidding.

Also, if we did not win any slot the result is the same if we had bid less.

For $T = 10000$ it might make sense to overbid in the early rounds as to drive players to bid higher and lose their budget earlier in the game giving the player a higher chance to win better ad slots.

2 Part B

If everyone played truthfully it may not be an equilibrium as one of the players who won the positions 4 to 9 can choose to bid less and win the respective lower slot and get the same revenue and the payment is less.

3 Part C

3.1 proportional

This strategy bids a factor of the value. This factor is increases as the number of past rounds increases.

3.2 adapter

This strategy tries to learn the least factor of the value it can bid and still win. This is implemented by increasing the factor in case the player did not win any slot and decreasing if he won any slot.

3.3 expector

The strategy tries to win the 9th position by bidding the average bid that won that position in the past.

4 Evaluation Techniques

4.1 N on N

A number N instances of each strategy A, is tested against all other strategies, but one strategy at a time. Then, a score is given to that strategy A according to the sum of the difference between the average performance of A and the average performance of the other strategy X. i.e.,

$$\texttt{score}_{NonN}(A) = \sum_{X \in \texttt{strategies} - \{A\}} \texttt{Performance}(A) - \texttt{Performance}(X) \tag{1}$$

Results

$N = 6$:

expector	-4306.525174471466
adapter	2101.7029639141388
truthful	-96.44870788343383
proportional	2277.1687745620893

Figure 1: $numTrials = 100$

4.2 Homogeneous

Each strategy is given a score equal to the average performance it gets when all the instances follow the same strategy.

Results

Obtained by running 50 instances for each strategy.

expector	777.8973639154184
adapter	1364.3053141967557
truthful	1088.204305895768
proportional	1690.8991342448076

Figure 2: $numTrials = 100$

4.3 Survival of the Fittest

It starts with a population of n_{start} instances from each strategy. Then, the worst performing instances (of a number equal to a percentage p_{worst} of the population) are discarded. The process repeats for multiple *"generations"* until all strategies are discarded. Each strategy is then given a score of the number of generations it survived.

Results

strategy	generations
adapter	21
proportional	15
truthful	7
expector	3

Figure 3: $numTrials = 100, n_{start} = 10, p_{worst} = 10\%$

4.4 All Combinations test

Given a set of strategies. A tournament is held on all subsets of this set. Then a score is given to each strategy that is equal to the sum of scores it has gotten in all subsets of size k.

Results

$k = 2$:

strategy	score
truthful	4496.682055457923
adapter	6781.635094028401
proportional	6511.516345853237
expector	1588.7648844472787

Figure 4: $numTrials = 100$

$k = 3$:

strategy	score
truthful	3735.7173029346404
adapter	6064.405691944758
proportional	5788.048733307711
expector	1500.0

Figure 5: $numTrials = 100$

$k = 4$:

strategy	score
truthful	1202.565884225385
adapter	1723.4835684247712
proportional	1764.3588683481507
expector	500.0

Figure 6: $numTrials = 100$