

Lecture 3

Problem Set Review

Auctions VCG & Internet Advertising a Private Sector Application

We began class with a short mid-term/ review set.

Then we moved on to see an example of how the demand revelation procedure can be applied in the private sector. Up until now, we have only examined applications involving the public sector. Let's explore how the VCG can be applied in the private sector, specifically focusing on internet advertising. I will review a paper called "*Internet Advertising and the Generalized Second Price Auction: Selling billions of dollars Worth of Keywords*" by Benjamin Edelman, Michael Ostrovsky, and Michael Schwarz.

A brief history of Internet Advertising

Edelman, Ostrovsky and Schwarz begin by reviewing the history of advertising on the internet. The very first advertisements on the internet were priced per showing. This means advertisers would pay money to show their ad say a 1000 times on a particular day. However, how do you know if anyone even looks at the advertisement? This could just be a waste of money. There's no way to figure out whether the advertisement *actually* caused a sale to occur.

Another approach to pricing would be that an advertiser paid a fee only when a user clicked on the advertisement and bought something.

These are two extremes. The first approach (pay per showing) is more beneficial to the web site which shows the advert. The second approach is more beneficial to the prospective advertiser.

Google and e-bay currently use a middle of the road approach: an advertiser pays a price whenever a user clicks on their advertisement.

The value of each advertising slot on Google is derived from the number of clicks associated with each spot. The higher the spot, the higher the number of clicks, and the higher the value of the position. Google calculates the probabilities of being clicked at different positions and then incorporates this into its analysis. See page 5 of Ostrovsky, Schwarz, and Edelman's seminal paper. Yahoo ignores these, and assumes each slot has the same probability of being clicked.

You can only submit one bid, even though several slots are available.

Generalized Second Price:

Yahoo and Google both use variants of the Vickrey auction, also known as the generalized second price auction. In this auction the winner pays the price of the second highest bid.

The following is an example from page 8 of *Internet Advertising & the Generalized Second Price Auction: Selling Billions of Dollars worth of Keywords*:

Example 1: under 2nd Price GSP :

Assume that there are two advertising slots. The top-most slot is worth 200 clicks, and the bottom-most slot is worth 100 clicks. If all advertisers bid truthfully, their bids are \$10, \$4, and \$2. Payments in GSP will be \$4 and \$2, so the value of the first slot is \$800 (200 clicks * \$4) and the value of the second click is (100*\$2) = \$200.

However, the Vickrey-Clarke Groves mechanism could also be used:

Example 2: under VCG

Assume that there are two advertising slots. The top-most slot is worth 200 clicks, and the bottom-most slot is worth 100 clicks. The three bidders value the ad at \$10, \$4 and \$2.

The first advertiser who values the good at \$10 can out bid both of the other advertisers. What is the externality that s/he imposes on the other bidders?

Well, if advertiser 1 was not present, and everyone truthfully revealed their preferences then advertiser 2 would pay \$400 and advertiser 3 would pay \$200. However, if we add advertiser 1, then he causes the following losses:

- Advertiser 2 loses 100 clicks valued at \$4. = \$400
- Advertiser 3 loses 100 clicks valued at \$200.

In this case, advertiser 1 pays \$600, and advertiser 2 pays \$200.

In this scenario, advertiser 1 pays a total of \$600. This is in contrast to the \$800 paid under the 2nd GSP (see example 1 directly above).

The VCG generates lower revenues for Google.

What if there was only one advertisement slot?

Example 4: GSP with one advertisement slot

Same as previous assumption, however, now there is only one advertising spot available. Advertiser 1 pays \$800. (\$4*200)

Example 5: With VCG mechanism

If Adv1 is not in it, then adv 2 gives up 200 clicks valued at \$4 equals \$800.

The Same Result!

The 2nd price GSP has the same result as the VCG if there is only one advertising slot! However, if you include more than one advertising slot, then they are no longer equivalent.

Having seen how easily the VCG can be applied to the public and private sector, we will turn our gaze to democracy. How can the VCG solve the fundamental problems of democracy?