Application domain: Internet advertising

The success of internet advertising

1. User data: advertisers can gather a lot of data of the user to design targeted products.

2. Measurable actions: can classify buyers into categories and measure the interest and take appropriate actions.

3. Low latency: real time bidding, automated bidding, decisions on the fly possible.

Types of ads on the internet

1. Sponsored search ad: advertisers bid on the keywords entered by the users during search.

2. Contextual ads: depending on the content of the page, post on email message.

3. Display ads: traditional modes of advertising, e.g., banner ads in newspapers.

Ads are complex - modern internet advertising is handled via ad exchanges.

Diagram:

- Publisher
- Ad Exchange
- Client/Advertiser
Small businesses can customize their ads via exchanges.

**Position Auctions:** auctions to sell multiple ad positions on a page.

Let \( N = \{1, 2, \ldots, n\} \) : set of advertisers

\( M = \{1, 2, \ldots, m\} \) : set of slots

assume: \( m \geq n \) - every ad is shown

1: best position, \( m \): worst position.

**Evolution of position auctions**

1. **Early position auctions** ordered the ads via *bid-per-impression*
   - just for showing the ad
   - newspaper ads, e.g.
   - all risk on the advertiser

2. **Bids on clicks - pay-per-click model**
   - risk is shared by the publisher
   - ranked by *bid-per-click*
   - shown ads are not clicked, publisher earns nothing

3. **Today’s approach:** rank advertisers based on the product of probability of click and bid value.
   - probability of click is called *click through rate (CTR)*
   - rank by expected revenue
Advertiser value

Assumptions: 1) clicks generate value to the advertisers
2) all clicks are valued equally - no matter what position
   the ad is displayed. The position only affects the chance of
   getting the click.

These assumptions help de-couple the value effect and position effect
Agent i’s expected value when her ad is shown at position
j ∈ M: \( v_{ij} = CTR_{ij} \cdot v_i \) — value of a click

\( CTR_{ij} \in [0, 1] \): probability of getting a click on i’s ad at j.

\( v_i \)

\( CTR_{ij} = C_i \cdot p_j \) — user effect, position effect

hence the expected value: \( v_{ij} = p_j (C_i v_i) \)

Position effect is assumed to be decreasing with position

\( p_1 = 1, \ p_j > p_{j+1}; j = 1, \ldots, m-1 \).

\( v_i \) is the only private information of the advertiser.

\( p_j \) and \( C_i \) are measurable

search engines estimate \( C_i \): say \( \hat{C}_i \)

bidders bid \( b_i \), ads are ranked in decreasing order of \( \hat{C}_i b_i \).