Search engine advertising

Hal Varian
Online advertising

• Banner ads (Doubleclick)
  – Standardized ad shapes with images
  – Loosely related to content
• Context linked ads (Google AdSense)
  – Related to content on page
• Search linked ads (Google Adwords)
  – Related to search terms
Examples

Banner ad

Content ads
Search ads

- Promoted ad
- RHS ads
- Search results
Search linked advertising

• High relevance
• Results in very good performance in cost-per-acquisition (adv expenditure per sale)
• Rapid growth but still small part of advertising market
  – Total US adv spend ~ $220 billion, growth ~ 1-2% per year
  – Online advertising: ~ $10 billion, growth ~ 26% last year
## Advertising spend

<table>
<thead>
<tr>
<th></th>
<th>Morgan- Stanley 04</th>
<th>Media Metrics 04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>65</td>
<td>57</td>
</tr>
<tr>
<td>Direct Mail</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Broadcast TV</td>
<td>45</td>
<td>43</td>
</tr>
<tr>
<td>Radio</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Cable TV</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>Magazine</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>Yellow Pages</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Internet</td>
<td>10</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>245</strong></td>
<td><strong>209</strong></td>
</tr>
</tbody>
</table>
Stock market valuation of Google
How does Google work?

- Advertiser bids on search terms
  - Can use “Traffic Estimator” to see how many clicks they will get
  - Can choose “exact” or “broad” match

- Ordering
  - Overture: high bidder gets first position, 2nd highest bidder second position, and so on, with exact match first.
  - Google: rank by bid x predicted CTR. Puts best ads on top of page.
Aligning incentives

• Google sells ad impressions (views)
• Seller generally wants clicks and ultimately conversions (purchases)
  – Rank ads by how much advertisers are willing to bid for impressions
  – Value/click * clicks/impr = value/impr
  – Disable added if there are too few clicks per impression (CTR)
How do you estimate pCTR?

• Basic model
  – Actual CTR = position effect x ad effect
  – Determine position effect by randomization
  – Determine ad effect by statistical analysis
  – pCTR = ad effect (also a quality signal)

• Implementation is difficult due to scale and performance requirements
Payment

• Price you pay depends on bidder below you
  – Overture: pay bid of bidder below you
  – Google: pay minimum necessary to keep your position ("AdWords discounter")

• Why not pay your actual bid?
  – Would then want to cut bid to just enough more than adv below you to keep your position
  – With discounter don’t need to constantly inspect bid landscape
Vickrey auction

• Similar in spirit to proxy bidder on eBay or Vickrey auction in economics

• One item to sell, many bidders
  – English auction: person with highest value wins, pays price equal to second highest value + bid increment
  – Vickrey auction: award item to highest bidder, who pays 2nd highest price

• Always want to truthfully reveal your value in Vickrey auction
Vickrey auction

- Payoff $= (v - b_2) \text{Prob}[b > b_2]$
  - If $(v - b_2) > 0$, then want to make Prob as large as possible
  - If $(v - b_2) < 0$, then want to make Prob as small as possible
  - Either way truthtelling is optimal
- Ad auctions don’t quite have this property, but analysis is similar
Mechanism design

- This is an example of an economic mechanism
  - Agents report messages to center
  - Center makes choices based on messages
  - Agents make payment to center based on messages and outcome of choices

- Problem: incentive compatibility
  - Surprisingly, can find an incentive compatible mechanism for wide variety of cases
  - Vickrey auction is relevant example
Biggest auction in the world

- According to Comscore, there were 4.8 billion web searches worldwide July 2005
- Roughly half of those searches displayed ads, so that’s 2.4 billion auctions per month
- This is a very conservative estimate…
Ads system from viewpoint of seller

• Choose your creative text
  – Standardized size
  – Various tips available to aid choice

• Choose your keywords
  – Exact, broad, phrase, negative keyword
  – Follow ad guidelines

• Implement conversion tracking if desired
Setting up ad, cont.

• Choose your bid = maxCPC
  – Value of a click = prob of sale * profit per sale
  – Can use Traffic Estimator to see how many clicks you will get
  – Discounter will set actual CPC to minimum amount necessary to retain position

• Set daily budget
• Let ‘er rip
AdSense Program

• “Content ads”
  – Use keyword matching engine to pick ads related to content on page
  – Matching algorithm tweaked to deal with multiple content on page
  – Auction needs tweaking to deal with position effects
  – Generally lower CTRs, lower conversion performance, so adjustments made in payment to compensate for performance difference
Technology

• Engine to match ads to queries
  – Choose most relevant ads using various criteria (plurals, synonyms, elimination of duplicates, etc.)
  – Returns up to 10 ads to show on a page
  – Promotion policy: depends on CTR performance and CPC. Best ads get best position.

• Auction engine
  – Ranks ads by CPM, records clicks, payments, etc.
Factors affecting revenue

Monetization (RPM) = \frac{\text{Revenue}}{\text{Queries}} \times (1K)

= \frac{\text{Revenue}}{\text{Clicks}} \times \frac{\text{Clicks}}{\text{Queries}}

= \frac{\text{Revenue}}{\text{Clicks}} \times \frac{\text{Queries w/ Ads}}{\text{Queries}} \times \frac{\text{Ads}}{\text{Queries w/ Ads}} \times \frac{\text{Clicks}}{\text{Ads}}

= \text{CPC} \times \text{Coverage} \times \text{Depth} \times \text{CTR per Ad}

\begin{align*}
\text{Price} & \quad \text{Quantity} & \quad \text{Quality}
\end{align*}
Increasing revenue

• Increase CPC
  – Create higher conversion prob for advertiser
    • “Advertiser optimization”
  – Capture more value by increasing competition
    • Acquire more advertisers

• Increasing coverage
  – Get more keywords
  – Match more broadly (affects CTR – like precision/recall tradeoff)

• Increase depth
  – Get more advertisers, more ads via optimization/marketing

• Increase CTR
  – Show more relevant ads
Advertiser optimization

- Choose good creatives, follow tips
- Determine your value per click
  - Can use Google’s conversion tracking
  - Or use your own tool
- Maximum bid = maximum value per click
  - Shade down depending on competition
- Minimums
  - Bid: 5 cents
  - Min CTR: around 1%
Syndication network

• Can syndicate search and/or ads
  – AOL = both
  – Ask Jeeves = ads only
  – Yahoo (formerly) = search only
  – MSN formerly served by Overture/Yahoo

• Negotiated revenue share with partners
  – Intensive bidding against Overture/Yahoo

• Content ads network
  – Typically fixed revenue share
  – Provides business model for small web sites
Competition

• Search
  – Intensive competition to improve search
  – Hampered by attempts to manipulate algorithm
  – Entrant has an advantage!

• Monetization
  – Size of ad network
  – Non-exclusive nature – a “media business” like magazines
  – Can partner in various ways, co-opetition issues
Business challenges

• Scale
  – Large, complex system: keeping it running and improving it is a challenge

• Advertising guidelines
  – Detection and enforcement
  – Regulatory issues

• Fraud
  – Credit card fraud
  – Click fraud
  – Spam of various sorts

• Advertiser relations – as online advertising gets more popular, it gets more expensive