Google's sponsored search – eBay auctions

Auction Theory

- Consumers generally purchase goods and services at a price stipulated by the seller.
- Auctions are an alternative "allocation mechanism", or purchasing method, where it is consumers themselves that set the price of goods. Indeed, buyers make offers or price bids on items based on their willingness to pay, and auctioneers sell the item to the highest bidder.
- This sounds like a favourable system for consumers, who could end up paying less for goods based on their purchasing power.

What is Auction Theory Used for in Real Life?

- Every time a Google user types a word or sentence in their search tab, a list of websites will appear for the user to click on. This seems simple and rather familiar, but a lot more is going on behind the scenes.
- An auction is the mechanism that dictates the order in which these websites appear on the users' device.
- More specifically, a second-price sealed bid auction.
- These auctions take place in Google's online portal called Google Ads, where firms whose product or service is relevant to a user's search will compete in an auction to position their product higher up amongst the list of search results, increasing the chances of getting clicked on by the user.

Google Auction

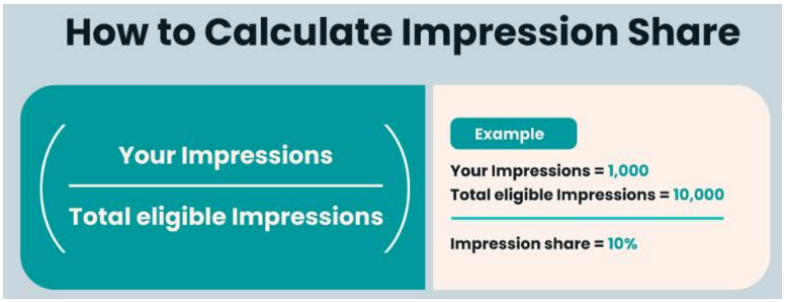
- Almost every search query a user conducts via the Google search engine triggers an auction to determine which advertiser's ad is served to the user.
- These automated auctions take place within a fraction of a second, considering various factors to decide where and if ads rank on the search engine results page and how much advertisers pay.
- When advertisers open up a Google Ads account, thier next steps after taking care of administrative tasks are to choose keywords they want to serve ads for, create ads, and develop a bidding strategy that informs Google as to how much they are willing to pay per click.
- In real life, it takes weeks to develop a strategy, set up an account, and do the proper market and keyword research when getting started with a Google Ads account.
- During the auction, Google's algorithm ranks ads based on many factors that have evolved. These factors include:
- **Bids:** The maximum CPC the advertiser sets.

The Ads' Quality: The quality of an ad is determined by the ad's, keyword's, and landing page's relevance to a search query, the expected click-through rate of the ad, and landing page experiences after clicking on the ad

- **Competitiveness of an Auction:** A query such as "lawyers" is highly competitive, therefore advertisers expect to pay a premium price to serve ads for that search query.
- **Context of the Search:** Google factors in many contextual factors centered around the user. These factors are, but not limited to location, device, time, intent, other ads, search results, and user signals and attributes.
- **Expected Impact of Extensions and other Ad Formats:** Google places a premium on the use of ad extensions. Ad extensions are extensions of ads that take into consideration the context of the search query to give the user more information about a business, product, or service. One of the most useful ad extensions are call extensions. Call extensions allow users to call advertisers directly from the search engine results page.
- **Meet Ad Rank Thresholds:** There are thresholds Google sets for each auction based on the factors listed above. In other words, if an advertiser does not meet Google's minimum requirements, they will not be able to bid in an auction.
- This auction is referred to as a ***second-price auction***. When you enter a "first-price auction," the amount you bid is the amount you pay. In a "second price auction," advertisers don't pay what they bid — *they pay just enough to beat the next ranked ad's bid.*
- The second price auction produces two distinct CPC metrics or ***"costs per click,"*** the ***Max CPC*** bid and the ***average CPC***. Your max CPC is the maximum amount you are willing to pay for a click, while your average CPC is the average amount you have paid for clicks over a given period.
- Google's primary selling point is that the search engine serves search results precisely to satisfy the intent of the search query. **The search engine produces quality results that answer questions with reliable information, up-to-date resources, and various links.**
- Therefore, it's in Google's best interest to derive the best experience possible for its user. It does this by incentivizing quality ads by giving a discount to the best ads in the form of a quality score.
- If your ads are of low quality, you have to pay a lot more for Google to show your ad to its users. If Google deems your ads are high quality, you can win a higher position at a lower price even if your competitors bid higher than you.
- Optimizing your Google Ads account is entirely based on increasing the quality of your ads to drive better results at the lowest cost possible and it all starts with understanding how the auction system works.

Key Auction Insight Metrics

- This metric reveals the percentage of impressions your ads received out of the total number of impressions they were eligible to receive.



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Overlap Rate

- Overlap rate shows how often your ads and another advertiser's ads received impressions in the same auctions. This metric can help identify your main competitors and understand the competitive landscape of your ad space.

Position Above Rate

- Understanding how often another advertiser's ad was shown in a higher position than yours can be crucial for assessing ad rank and the effectiveness of your bid strategy.

Top of Page Rate / Absolute Top of Page Rate

- These metrics indicate how often your ads appear at the top of the search results page and in the absolute top position, respectively. High rates here are indicative of successful bid strategies and high ad relevance.

Outranking Share

- This measures how often your ad ranked higher in the auction than another advertiser's ad or was shown when theirs was not. It's a direct indicator of your competitive advantage in ad placement.

4 Steps To Apply Insights to Competitor Analysis

1. Identify Strong Competitors

- Use the Auction Insights to identify which competitors frequently outperform you in key metrics. This can highlight who your main rivals are in the digital space and where you need to focus your competitive strategies.

2. Strategic Bid Adjustments

- Based on your impression share and outranking share, you may decide to increase bids/targets on high-value keywords where you're close to outranking competitors or decrease bids in areas where the ROI does not justify the investment.

3. Refine Targeting and Ad Content

- Overlap and position above rates can guide adjustments in your ad targeting and content.
- If your competitors are consistently appearing above you, it may be time to revisit your ad copy, ensuring it's compelling and closely aligned with the search intent of your target keywords.

4. Explore New Opportunities

- A thorough competitor analysis might reveal gaps in your competitors' strategies that you can exploit.
- Eg: If you have high-value campaigns/ad groups and your main competitors have a *low* impression share, these could represent opportunities for you to capture additional market share.

3 Best Practices for Utilising Auction Insights

1. Combine Routine Analysis With Broader Campaign Data

- Regularly review your Auction Insights to stay ahead of trends and shifts in the competitive landscape.
- Integrating these insights with *other* reports (like the Search Terms report), can provide a more holistic view of your campaign's performance and opportunities for better optimisation.

2. Prioritise Actionable Metrics (And Avoid Data Overload)

- Focus on metrics that directly inform actionable strategies.
- For instance, if improving visibility is a goal, prioritise impression share and top of page rate over other metrics.

3. Gain The Competitive Edge Through Ongoing Optimisations

- Use insights from the report to continually refine your campaigns. This means adjusting bids/targets, experimenting with different ad copy, and refining target keywords based on ongoing performance and competitive pressure.

Assignment Model

- Positions $k = 1,\ldots,K$
- Bidders $n = 1,\ldots,N$
- Position k gets x_k clicks per day: $x_1 > x_2 > \ldots > x_K$
- Bidder n has value v_n per click: $v_1 > v_2 > \ldots > v_N$.
- Bidder n's value for position k is: $v_n * x_k$.
- Bidder n's profit if buys k, pays p_k per click: $(v_n - p_k) * x_k$.
- Efficient, or surplus maximizing, assignment is to give position 1 to bidder 1, position 2 to bidder 2, etc.

Example

- Two positions: receive 200 and 100 clicks per day
- Bidders 1,2,3 have per-click values $10, $4, $2.

	Top	2nd
Bidder 1	2000	1000
Bidder 2	800	400
Bidder 3	400	200

- Efficient allocation creates value $2400
  - Bidder 1 gets top position: value 200*10 = 2000
  - Bidder 2 gets 2nd position: value 100*4 = 400

Market Clearing Prices

- Solve for the market clearing "per-position" prices

	Top	2nd
Bidder 1	2000	1000
Bidder 2	800	400
Bidder 3	400	200

- Lowest market clearing prices: 600 and 200
  - Bidder 1 prefers top position
  - Bidder 2 prefers 2nd position
  - Bidder 3 demands nothing.

"Per Click" Prices

- Market clearing position prices are 600 and 200.
- Positions receive 200 and 100 clicks per day
- This equates to $3 and $2 *per click* for the two positions.

- Check: per-click prices $p_1 = 3$, $p_2 = 2$ clear the market
  - Bidder 3 wants nothing: value is only \$**2** / click.
  - Bidder 2 wants position 2: 100*(**4**-2) > 200*(**4**-4) = 0
  - Bidder 1 wants position 1: 200*(**10**-4) > 100*(**10**-2)
  - Efficient outcome with revenue: \$600+\$200= \$800

Find All Market-Clearing Prices

- Positions get 200 and 100 clicks.
- Bidder per click values 10, 4, 2.
- Bidder 3 demands nothing: $p_1 \geq 2$ and $p_2 \geq 2$
    - Bidder 2 demands position 2: $p_2 \leq 4$ and $2p_1 \geq 4+p_2$
  - Prefers 2 to nothing: $100*(4-p_2) \geq 0$
  - Prefers 2 to 1: $200*(4- p_1) \leq 100*(4- p_2)$
- Bidder 1 demands position 1: $2p_1 \leq 10 + p_2$
  - Prefers 1 to nothing: $200*(10-p_1) \geq 0$ (redundant)
  - Prefers 1 to 2: $200*(10 - p_1) \leq 100*(10 - p_2)$

Price Premium for More Clicks

- At market clearing prices, bidder k wants to buy k
- Therefore bidder *k* prefers position *k* to position *k-1*

$(v_k - p_k) * x_k \geq (v_k - p_{k-1}) * x_{k-1}$

- We know that $v_k \geq p_k$ and also that $x_{k-1} \geq x_k$.
- Therefore, it must be the case that $p_{k-1} \geq p_k$.
- *Per-click* prices must be higher for better positions

Finding Market Clearing Prices

Suppose more bidders than positions, so N>K.

- Set p_K so that bidder K+1 won't buy: $p_K = v_{K+1}$
- Set p_k so that bidder k+1 will be just indifferent between position k+1 and buying up to position k:

$(v_{k+1} - p_k) * x_k = (v_{k+1} - p_{k+1}) * x_{k+1}$

This works as an algorithm to find lowest clearing prices.

- To find highest market clearing prices, set $p_K = v_K$ and set p_k so that bidder k is just indifferent between k and k+1.

Pay-as-Bid

- Two positions: receive 200 and 100 clicks per day
- Bidders 1,2,3 have per-click values $10, $4, $2.
- Overture auction (pay as bid)
    - Bidder 3 will offer up to $2 per click
    - Bidder 2 has to bid $2.01 to get second slot
    - Bidder 1 wants to bid $2.02 to get top slot.
    - But then bidder 2 wants to top this, and so on.
- Pay as bid auction is unstable!

GSP auction

- Recall bidder values 10, 4, 2, and clicks 200 and 100.
- Another Nash equilibrium of the GSP (w/ higher prices)
- Bidder 1 bids $6, Bidder 2 bids $5, Bidder 3 bids $3.
- Verifying the Nash equilibrium
    - Bidder 3 doesn't want to pay $5 or more to buy clicks
    - Bidder 2 is willing to pay $3 per click for the second position but doesn't want to pay $6 per click for position 1.
    - Bidder 1 prefers to pay $5 for top position rather than $3 for bottom position because 200*(10-5) > 100*(10-1).
- Prices in this equilibrium are $5 and $3.
- Recall bidder values 10, 4, 2, and clicks 200 and 100.
- Yet another GSP equilibrium – w/ lowest clearing prices!
- Bidder 1 bids $10, Bidder 2 bids $3, Bidder 3 bids $2
- Verifying the Nash equilibrium
    - Bidder 3 doesn't want to pay $3 or more for clicks
    - Bidder 2 doesn't want to pay $10 per click to move up.
    - Bidder 1 pays $3 for top position, better than $2 for bottom because profits are 200*(10-3) > 100*(10-2).
- In this equilibrium, per-click prices are $3 and $2.

Vickrey Auction

- Bidders submit bids ($ per-click)
- Seller finds assignment that maximizes total value
    - Puts highest bidder in top position, next in 2nd slot, etc.
- Charges each winner the total value their bid displaces.
    - For bidder n, each bidder *below* n is displaced by one position, so must add up the value of all these "lost" clicks.

- Facebook uses a Vickrey auction.
- Dominant strategy to bid one's true value.

Vickrey Auction Pricing

- Order per-click bids: $b_1 > b_2 > \ldots > b_N$
- Consider bidder who wins kth slot.
  - Displaces k+1,…,K.
  - Leaves 1,…,k-1 intact.
- Displaced bidder j would get x_{j-1} clicks in position j-1, but instead gets x_j clicks in position j.
- Bidder k pays: $\sum_{j>k} b_j(x_{j-1} - x_j)$
- Note: in GSP k pays: $b_{k+1}x_k$

Position	With bidder k	No Bidder k
1	b_1	b_1
2	b_2	b_2
…	…	…
k-1	b_{k-1}	b_{k-1}
k	b_k	b_{k+1}
k+1	b_{k+1}	b_{k+2}
…	…	…
K	b_K	b_{K+1}

Vickrey Auction Example

- Recall bidder values 10, 4, 2, and clicks 200 and 100.
- Vickrey payment for Bidder 2
  - Bidder 2 displaces 3 from slot 2
  - Value lost from displacing 3: \$2 * 100 = \$200
  - So Bidder 2 must pay \$200 (for 100 clicks), or \$2 per click.
- Vickrey payment for Bidder 1
  - Displaces 3 from slot 2: must pay \$200
  - Displaces 2 from slot 1 to 2: must pay \$4*(200-100)=\$400
  - So Bidder 1 must pay \$600 (for 200 clicks), or \$3 per click.
- Vickrey "prices" are $p_2 = 2$ and $p_1 = 3$, revenue \$800.