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EveryDay Medical – Keyword Bidding Optimization

BY COSTIS MAGLARAS*

ABSTRACT

EveryDay Medical, a provider of home and durable medical equipment and supplies, uses Internet advertising to attract potential customer flow to their website. With many thousands of potential keywords to bid on and a tight budget for online advertising, EDM turned to Jeremy Gerstle to help them develop a quantitative tool to optimally manage their internet advertising campaign.

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* Professor, Columbia Business School

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Introduction

Jeremy Gerstle (Columbia Business School '07) had just finished his second phone call with EveryDay Medical (EDM), his new pricing optimization client. The issue at hand was one he knew intimately – how to help EDM, a provider of home and durable medical equipment and supplies, optimize its online advertising account and bid management practices.¹

A former engineer and computer science specialist, Jeremy had recently founded Real Optimal, LLC, a startup Search Engine Marketing (SEM) firm. In this capacity, he was responsible for the development of SEM optimization algorithms for Real Optimal's clients (mostly small to mid-sized businesses).

Online advertising, a booming new business, was forecast to revolutionize the traditional advertising industry, and as Jeremy put it, "Online advertising is an intellectually diverse discipline that blends elements of economics, information retrieval, machine learning, statistics, and social behavior/psychology."

EveryDay Medical

Founded by Columbia Business School professor and serial entrepreneur Cliff Schorer, EveryDay Medical's mission was:

To provide quality, innovative services to assist individuals and their caregivers in managing and treating illness and disease and promoting the improvement of personal health. Our goal is to be one of the nation's leading providers of home and durable medical equipment and supplies by creating innovative systems of care that help people achieve and maintain their best possible state of health. We will focus, plan, and act on our commitments to our mission, to our customers, and to the highest quality standards of healthcare to achieve our vision for the future.²

Schorer described his company's focus as follows: "Our number one priority is to provide you the best customer service on the best products at the best price – EveryDay!"

Online Advertising

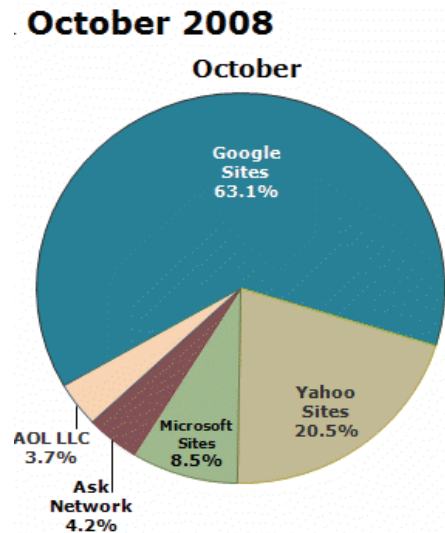
In terms of size and growth, worldwide spending on Internet advertising totaled \$65.2 billion in 2008 (about 10% of all ad spending across all media) and was projected to reach \$106.6 billion in 2011 (13.6% of total ad spending).

¹ Bid management is the process of determining how much to bid in any pay-per-click media in order to achieve desired business goals.

² EveryDay Medical Business Plan

Keyword search ads would remain the dominant type of Internet advertising from 2008-2011, capturing more than one third of annual online ad spending worldwide. Figure 1 describes the competitive landscape.

FIGURE 1
OCTOBER 2008 INTERNET ADVERTISEMENT MARKET SHARE



Historically, Internet Pay per Click (PPC) advertising was based on an auction system whereby the higher paying advertisers gained greater access to potential customers. This did not account for the genuine relevance of advertisers to their particular keywords. In mid-2002, the U.S. Federal Trade Commission warned the industry that users were mistaking PPC advertisements for unpaid ones that were based simply on their relevance to the respective search.

Google AdWords³

In February 2002 Google introduced AdWords, which shaped the Internet PPC advertising industry. Google AdWords was a quick and simple way to advertise on Google and its ad partners, regardless of one's budget. AdWords ads were displayed along with search results on Google, as well as on search and content sites in the growing Google Network, which included websites like AOL, EarthLink, HowStuffWorks, and Blogger.

With AdWords, users were able to associate keywords with their ads for search results on Google and its search partners, and also specify the maximum amount of money they would be willing to pay for each click (users paid only when someone clicked on their ads).

³ To find out more about Google AdWords or to begin creating your ads, you can visit the AdWords home page at adwords.google.com/select.

When users created an AdWords ad to run on the Content Network, they either chose the exact content placement where their ads would appear, or allow the contextual targeting to choose by matching keywords to content. Users were given the option to pay for each click (CPC) or for every thousand times someone saw their ads (which is called CPM bidding).

AdWords automatically reduced the actual cost per click (or CPC) that clients paid to the lowest cost needed to maintain their ads' position.

The key innovations introduced were:

1. Listings were ranked not only by bid amount, but also by Quality Score. An ad with a high Quality Score could therefore gain a higher position than a competing ad with a higher bid, but a lower Quality Score. (This is explained in Exhibit 2.)
2. Bidders did not pay the full amount of a bid; instead they paid one penny more than the bid below (or, if the bidder's bid was the lowest, her or she paid the minimum).
3. Ads could be targeted to a large number of countries and/or languages.
4. Ads could be targeted to particular search terms, using the following keyword matching options:
 - a. **Broad Match**
Ad would be eligible to appear when a searcher's search query contained "tennis" and "shoes" – in any order, along other words, and in any variation.
 - b. **Phrase Match**
Ad would be eligible to appear when a person searched on the phrase "tennis shoes," in this order, and possibly with other terms before or after the phrase.
 - c. **Exact Match**
Ad would be eligible to appear when someone searched for the specific phrase "tennis shoes," in this order, and without any other terms in the query.
 - d. **Negative Keyword**
If negative keywords were added, the ad would not appear when a searcher used the negative keyword in the search.

EDM's Keyword Bidding Strategy

Each month EDM budgeted \$10,000 to spend on Adwords, representing 25% to 30% of monthly revenue. The company believed that the competition was able to achieve advertising costs between 10% and 15% of revenue. EDM wanted to increase its profitability while simultaneously trying to double its revenues in the next year from a run rate of \$500,000 to \$1 million.

The company drove two-thirds of its revenues from manual wheelchairs, rolling walkers, and various other medical products and aids for daily living needed by the disabled and elderly. The average order value for such items was \$100, and nearly 90% of sales were driven from PPC advertising. The company historically had taken a “cast a wide net” approach: bidding for top positions primarily on broad match keyword terms. A significant number of clicks and cost came from searchers forming search queries that included terms or phrases such as “discount wheelchairs” and “wheelchairs for rent” – EDM attempted, through clever ad copy, to draw in customers by suggesting that their wheelchairs could be purchased for less than they cost to rent. However, buried in the volume of searches that matched these broad terms were much more specific terms, such as “Medicare discount on wheelchair,” “ultra-light weight wheelchairs,” and even product specific searches such as “tracer ex2 wheelchair.”

EDM contacted Jeremy to help them with optimizing its keyword bidding strategy to maximize profit. For a given keyword, bidding too aggressively would generate additional clicks –at a risk, however, of paying more per additional click than what EDM could expect to earn from each of these clicks. On the other hand, bidding too conservatively might have resulted in ads appearing against fewer searches and in lower positions on the search results page, correlating to fewer clicks that might have turned out to be profitable.

Looking across search data provided by EDM, Jeremy observed a fat-tailed frequency distribution of searches ranging from the obtuse “wheelchair” to the very narrow “tracer ex2 wheelchair for less than \$200 in Wilkes-Barre, PA.” In general, it was believed that more targeted matching of keyword phrases to queries tended to generate higher click-through rates as a function of both increased relevancy and lower competition. Clicks on these long-tail terms also exhibited increased conversion rates (often 1-for-1), even though such searches and clicks were highly infrequent.

Jeremy was faced with a difficult problem: which combination of keyword phrases, match types, and bids would generate the highest ROI for EDM’s budget? Jeremy’s goal was to find the optimal bid for each keyword that would yield the maximum amount of profit for EDM within their budget constraints, taking into account that EDM’s historical conversion rate was 1.3% (i.e., 13 out of 1000 customers who clicked actually ended up making an online purchase).

Questions

The first two questions will focus on the problem of optimizing the profitability of EDM’s online advertising campaign for the three keywords identified in Exhibit 3 (also available at EDM-data.xls). EDM can expect to earn \$100 in profit on each wheelchair rental before advertising expenses, and it is willing to allocate no more than \$10 per day to this advertising campaign.

The profit function for keyword i is computed as follow. Let:

- B_i = bid for keyword i
- $X_i(b_i)$ = # of clicks that result from searches for keyword i expressed as a function of the bid b_i

= # searches where EDM's ad was placed in Google's result page, and the user subsequently clicked on the EDM ad

- $C_i(b_i)$ = average cost per click from a keyword i search expressed as a function of the bid b_i

$$Profit_i = X_i(b_i) * (conversion\ rate)_i * (Conversion\ profit\ before\ advertising)_i - X_i(b_i) * C_i(b_i)$$

The total profit is given by: $\sum_{keywords\ i} Profit_i$

1. How much do you recommend EDM bid for each of the three keywords given EDM's budget allocation of \$10? (*Hint: Use the results in Table 2 of Exhibit 3 to estimate models that describe the number of clicks through keyword i as a function of the bid for that keyword, and for the cost per click at that keyword again as a function of the corresponding bid. Then formulate an optimization problem to choose the bids to optimize the total expected profit subject to the budget constraint.*)
2. How much do you recommend EDM bid for each keyword if EDM does not impose the budget restriction? How does this solution compare to the solution in Question 1?
3. Describe in broad terms an approach that EDM could follow to optimize its keyword bidding strategy across all of its keywords.

Exhibits

Exhibit 1

AdWords' Competitive Advantages

	Typical cost-per-click advertising site	Google AdWords	Google advantage to you
Competitive Pricing	Static CPC leaves a gap between your price and your closest competitor.	AdWords Discounter automatically monitors your competition and lowers your CPC to one cent above theirs.	You save money by minimizing your price.
Ranking	Ads assigned positions based solely on CPC. Allows for "squatting" in the top positions by irrelevant advertisers.	Rank is determined by a combination of several relevance factors including CPC and clickthrough rate. If an ad is irrelevant to users, they won't click on it and it will move down the page. Your relevant ads will gain higher positions on the page, at no extra cost to you.	Your ad can rise above someone paying more if it is highly relevant for a specific keyword.
Campaign Management	Only one ad per keyword you select.	Multiple ads per keyword. Google tracks individual ad performance to help you monitor which ones perform well.	Saves you time setting up your campaign and monitoring it.
	Must actively monitor your campaign to ensure you're not overpaying for your position.	AdWords Discounter takes care of your campaign for you, dynamically raising and lowering your CPC within the range you specify to keep you in the position you want.	Saves you time AND money.
Timing	Ads go live 3-5 days after you submit them.	Ads go live almost immediately once you create them.	No waiting for your ads to show up.
Minimum Deposit to Start	US\$50.00 minimum deposit at initiation	US\$5.00 total startup cost	US\$45.00 savings right from the start.
Monthly Minimum Fee	None	None	You never pay US\$20.00 for five cents USD in clickthroughs.
When Billed	Pay deposit upfront and monthly minimum.	Billed only for clicks received, after they're received.	You pay only for clicks you've already received.
Budgeted Delivery	No way to schedule ad delivery evenly over a set period of time.	Set daily budget for your campaign. Continuous delivery each day over the time period at that level.	You control the timing of your ad deliveries.
Target by Country or Language	Automatically displays your ads to anyone who searches on your keywords, regardless of what country they're in or language they speak.	You can target your ads to hundreds of countries and over a dozen languages.	You have more control over your ads so you can be sure they are only shown to a highly targeted audience.
Tools	Keyword tool only suggests other phrases containing your keyword.	Enhanced keyword tool provides lists of additional phrases to consider and most popular synonyms based on billions of searches. Results in better targeting and higher clickthroughs.	Expands your reach and gives you more new customers.
Ad Groups	Must set & monitor price for each keyword. Not possible to group ads or create campaigns.	Set a maximum price for an individual keyword or a group of keywords.	Greater flexibility in how you set up your ad campaign.

Source: <https://adwords.google.com/select/comparison.html>

Exhibit 2

Quality Score

The precise calculation of the Quality Score is proprietary to Google and unknown to the advertisers; however, it is known, in broad terms, that it takes into account the historical click-through rates, relevance of an advertiser's ad text and keywords, an advertiser's account history, and other relevance factors as determined by Google. Google also uses it to determine the minimum bids for an advertiser's keywords. The minimum bid takes into consideration the quality of the landing page as well, which includes the relevancy and originality of content, navigability, and transparency into the nature of the business.

POSITIONING AND RANKING

Ads are positioned based on the Ad Rank, a product of matched keyword's cost-per-click bid (CPC) and Quality Score. The ad with the highest Ad Rank appears in the first position, the ad ranked second underneath the first, and so on down the page.

$$\text{Ad Rank} = \text{CPC} \times \text{Quality Score}$$

This formula is calculated for each keyword individually and recalculated every time the search is performed. The advertiser only pays the CPC necessary to achieve a rank number higher than that of the next lowest ad on Google, as illustrated by the following example:

Advertiser	Max CPC	Quality Score	Rank #	Position	Min bid	Actual CPC
A	\$ 0.40	1.8	$\$0.40 \times 1.8 = 0.75$	1	\$0.04	\$0.37
B	\$ 0.65	1.0	$\$0.65 \times 1.0 =$	2	\$0.05	\$0.39
C	\$ 0.25	1.5	$\$0.25 \times 1.5 =$	3	\$0.04	\$0.04

In this scenario, we have three advertisers running ads on the same keyword. Each advertiser has a different maximum CPC, Quality Score, and minimum bid.

A has the highest rank number, 0.75, giving them Position 1. The next step is to calculate the Actual CPC: how much would Google actually charge each advertiser for a click on his or her ad. This is the minimum amount needed to maintain a rank number higher than the next lower ad. This is \$0.01 more than the amount that would cost your ad to appear in the next lower position. However, if your minimum bid is higher than \$0.01 more than the minimum amount needed to maintain your rank, you will be paying that minimum bid amount to keep your keyword active.

For Advertiser A, we divide B's rank number by A's Quality Score. The result is the amount that would cause A's ad to appear in B's position, or \$0.36. To appear above that position, we add \$0.01 to this amount. This results in an actual CPC of \$0.37.

Similarly, for B, we divide C's rank number by B's Quality Score. This gives us \$0.38, or the amount that would cause B's ad to appear in C's position. To appear above that position, we add \$0.01 to that amount. This yields \$0.39.

Finally, we have C. Since there is no ad below C's ad, we simply charge C the minimum CPC of \$0.04.

Notice A is paying less than B, even though A is at a higher position. This happens because A has a higher Quality Score, which is Google's way of measuring the relevance of an ad. So ads are rewarded for relevance by ranking them on the basis of CPC and Quality Score.

Exhibit 3

EveryDay Medical's Website: www.EveryDay Medical.com

TABLE 1
RENTAL WHEELCHAIR KEYWORDS ADWORDS DATA

Keywords	Clicks	Total Cost	CPC	Conversions	Conversion %	Cost Per Conversion
rent wheelchair	1024	826.35	\$0.81	11	1.07%	\$ 75.12
rental wheelchair	816	730.73	\$0.90	9	1.10%	\$ 81.19
wheelchair rental	5311	4190.64	\$0.79	78	1.47%	\$ 53.73

EveryDay Medical has 35 campaigns, wheelchairs being one of them. For this campaign there are 34 Adgroups, rental being one of them. This rental Adgroup has five keywords: wheelchair rental, rent wheelchair, rental wheelchair, rent wheelchairs, and rental wheelchairs. We use the campaign management tool and get the one-year historical (actual) data for three of these five keywords. The date range used was October 1, 2007 to October 1, 2008. This data is given in EDM_data.xls, and some of the information that is relevant for the questions of the case is summarized in Table 1 above.

TABLE 2
TRAFFIC ESTIMATOR TOOL DATA

Keywords	Max CPC	Estimated CPC	Estimated Clicks/Day
rent wheelchair	\$ 0.25	\$ 0.21	1.00
rent wheelchair	\$ 0.30	\$ 0.26	1.00
rent wheelchair	\$ 0.35	\$ 0.30	1.50
rent wheelchair	\$ 0.40	\$ 0.34	1.50
rent wheelchair	\$ 0.45	\$ 0.38	1.50
rent wheelchair	\$ 0.50	\$ 0.42	1.50
rent wheelchair	\$ 0.55	\$ 0.46	1.50
rent wheelchair	\$ 0.60	\$ 0.50	2.00
rent wheelchair	\$ 0.65	\$ 0.54	2.50
rent wheelchair	\$ 0.70	\$ 0.58	2.50
rent wheelchair	\$ 0.75	\$ 0.63	2.50
rent wheelchair	\$ 0.80	\$ 0.66	2.50
rent wheelchair	\$ 0.85	\$ 0.70	2.50
rent wheelchair	\$ 0.90	\$ 0.74	2.50
rent wheelchair	\$ 0.95	\$ 0.77	2.50
rent wheelchair	\$ 1.00	\$ 0.82	2.50

TABLE 2 (CONTINUED)

Keywords	Max CPC	Estimated CPC	Estimated Clicks/Day
rental wheelchair	\$ 0.25	\$ 0.23	6.00
rental wheelchair	\$ 0.30	\$ 0.26	7.00
rental wheelchair	\$ 0.35	\$ 0.30	8.50
rental wheelchair	\$ 0.40	\$ 0.35	9.00
rental wheelchair	\$ 0.45	\$ 0.38	10.00
rental wheelchair	\$ 0.50	\$ 0.43	11.50
rental wheelchair	\$ 0.55	\$ 0.47	12.50
rental wheelchair	\$ 0.60	\$ 0.52	12.50
rental wheelchair	\$ 0.65	\$ 0.56	13.50
rental wheelchair	\$ 0.70	\$ 0.61	14.50
rental wheelchair	\$ 0.75	\$ 0.65	14.50
rental wheelchair	\$ 0.80	\$ 0.69	15.50
rental wheelchair	\$ 0.85	\$ 0.73	15.50
rental wheelchair	\$ 0.90	\$ 0.77	16.50
rental wheelchair	\$ 0.95	\$ 0.80	16.50
wheelchair rental	\$ 0.25	\$ 0.23	6.00
wheelchair rental	\$ 0.30	\$ 0.26	7.00
wheelchair rental	\$ 0.35	\$ 0.30	8.50
wheelchair rental	\$ 0.40	\$ 0.35	9.00
wheelchair rental	\$ 0.45	\$ 0.38	10.00
wheelchair rental	\$ 0.50	\$ 0.43	11.50
wheelchair rental	\$ 0.55	\$ 0.47	12.50
wheelchair rental	\$ 0.60	\$ 0.52	12.50
wheelchair rental	\$ 0.65	\$ 0.56	13.50
wheelchair rental	\$ 0.70	\$ 0.61	14.50
wheelchair rental	\$ 0.75	\$ 0.65	14.50
wheelchair rental	\$ 0.80	\$ 0.69	15.50
wheelchair rental	\$ 0.85	\$ 0.73	15.50
wheelchair rental	\$ 0.90	\$ 0.77	16.50
wheelchair rental	\$ 0.95	\$ 0.80	16.50
wheelchair rental	\$ 1.00	\$ 0.85	17.50

ADWORDS TRAFFIC ESTIMATOR TOOL

The Traffic Estimator provides keyword search traffic and cost estimates at a glance.⁴ For any keywords you select, you can get the following information:

Maximum CPC (Cost-per-click):

This is the most you're willing to pay each time someone clicks the ad associated with your keyword. You can set this amount at the ad group or keyword level.

Search Volume:

Search volume information can help you determine how competitive ad placement is for a particular keyword. The green bar shown in your account represents a general low-to-high quantitative guideline.

Estimated Avg. CPC:

The average amount you'll pay for each click. AdWords automatically adjusts your actual CPC so you pay only one cent more than the minimum amount required to keep your ad's position.

Estimated Ad Positions:

The average position in which your ad may show. '1 - 3' is the highest range with 1 being the highest position on the first page of search results. Estimates are shown as ranges because ranges are the most precise representation of your potential ad performance. Due to the dynamic nature of the AdWords system, these estimates may fluctuate and are most influenced by the click-through rate (CTR) and Quality Score associated with your keyword. Ad positions are not fixed and may vary depending on your CTR, competitor activity, and keyword quality.

There are two versions of the Traffic Estimator Tool. The standalone version, accessed through the Campaign Management tab, does not take into account the quality score of your ad, hence providing a range of estimates for your ad position.

The other version can be accessed using the edit keywords tab and can only be viewed after your ads are running. These estimates are based on your keywords' performance and hence on the ad's quality score.

Table 2 utilized the standalone version of the Traffic Estimator Tool.

⁴ These estimates are for search on Google and search partner sites only; they don't include estimates for the number of clicks your ads might receive on placements you choose or on the rest of the content network.