

SPONSORED SEARCH ADVERTISING AND ITS IMPACT ON OPERATIONAL POLICIES

Public Defence Abstract

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1. Introduction

Over the past two decades, advertising has evolved from traditional offline to more online. The increased ability of users to interact with firms in the online world enabled a shift from “mass” advertising to more “targeted” advertising [1–3]. The ease of accessibility and user-friendly nature of the websites has also resulted in many firms opting to sell their wares online. This has further contributed to firms opting for greater presence on the online advertising platforms. As consumers increasingly use the internet to make purchases, it has become critical for sellers to appear as ‘results’ on the search engines. The topic of interest here is sponsored search. In the United States alone, sponsored search spending reached \$49 billion in 2014 compared to \$42 billion in 2013 [4]. The largest contributors have been retailers, who account for 22% of total sponsored search spending [4]. The predicted growth rates of sponsored search spending are almost 15% CAGR for the coming years.

1.1 Mechanism of Sponsored Search

Search engines have their own algorithms to compute the quality score of websites and list them on the results page. Quality score comprises of multiple factors such as relevance, metadata, landing page quality, click through rate, bid, etc.[5]. Significant customisation is possible in case of sponsored search. The advertisers using sponsored search can accurately track the keywords leading to maximum sales further encouraging usage of sponsored search. Search engines provide more measurability and accountability to the advertisers[6].

On the results page, there are two kinds of listings by any search engine- organic and paid. The top 3 results of a page and the ones on the extreme right of the search page are paid/sponsored listings. Paid listings can be influenced through the bid. The organic listings are generated based on click history, metadata, relevance, etc. The website can be enhanced using Search Engine Optimisation to feature in the organic listings [7]. Among several search engines that are operational, Google is the global leader with almost 70% market share[8][9]. It is observed that the rank (position) of the firm on the results page is directly related to the number of clicks generated[1]. Hence, the bidding decision plays a key role in sponsored search advertising.

Google offers various schemes of bidding- Cost per 1000 impressions (CPM), Cost per click (CPC), & Cost per Acquisition (CPA). In my thesis, I consider the CPC scheme as it is employed by both online and offline stores. I have analysed sponsored search advertising in three different contexts - fixed inventory, inventory replenishment and portfolio of bids on different keywords, namely generic and branded.

2. Sponsored Search Advertising and dynamic pricing under inventory-linked customer willingness to pay for perishable products

For an advertiser, it is important to keep the right amount of inventory, while driving more traffic to the website. Among the various issues that have emerged following the use of paid search for driving traffic to the website, linking inventory decisions to sponsored search advertising has become quite important. Coordinating inventory decisions with bids becomes pertinent if a retailer bids high and generates a substantial demand through sponsored search. The term “sale” creates a perception of scarcity in the minds of the customers, expediting their purchase process [10,11]. In other words, a customer has a higher willingness to pay when level of inventory is low. For instance, Flipkart’s “Big Billion Day Sale”, the sale of “Redmi” mobiles on Amazon, and the sale of “Yureka”

mobiles on Flipkart have set examples in explaining the importance of coordinating inventory decisions with bids. In all these scenarios, the online retailers promoted excessively and were unable to predict the demand surge leading to acute under stocking[12][13]. This creates an adverse effect on the customers in terms of lowering of future Click through rate, as they might be less inclined to visit the website to avoid disappointment. Social media reports suggest that a large number of customers vowed that they would not go back to purchase on Flipkart[14]. I have thus developed a model incorporating the customer's willingness to pay as a function of inventory on hand and suggesting optimal bid and price based on the level of inventory.

In this model, I analysed a retailer, with fixed inventory of product, who uses sponsored search advertising to attract customers to his website. Recently, some online retailers have started providing inventory availability information on their websites as this creates an urgency amongst customers [11][10]. I have thus modelled the customer reservation price as a function of inventory left. The retailer complements sponsored search bidding with dynamic pricing in a multi-period stochastic dynamic programming framework. The model yields optimal bid and price at the start of each time period.

As the inventory increases, the bid of the retailer gradually decreases. At low inventories, the reservation price of the customers is high implying a high willingness to pay and hence higher conversion probability. The retailer thus has an incentive to bid high and get customers to his website. At high inventories, the retailer uses price as a lever to enhance sales. It is optimal to offer discounts to maximize profits. I have also analyzed the effect of changing mean reservation price and variance of reservation price on the retailer's bids and prices. The retailer bids and prices higher when the variability in the customers' reservation price is high compared to the low variability case. It is optimal for the retailer to bid and price higher when the customers have a higher mean reservation price.

3. Joint Inventory Replenishment and Sponsored Search Advertising Decisions for Non-perishable items

Firms offer huge discounts on their products during the "Thanksgiving" and "Black Friday" holiday season in the US. Quite often, they resort to sponsored search advertising as well. It has been observed that customers tend to visit the top ranked links more often than the ones at the bottom [15]. Customers perceive the top ranked links to be of higher quality and hence are willing to pay a higher price for the product [16]. This implies the retailer would have to bid high to attract more visitors and also that the customer's willingness to pay is directly a function of the retailer's bid [1,15]. I am considering retailers who have an opportunity to replenish and therefore scarcity does not have much of an impact. Replenishing at the right moment helps prevent lost sales, in turn prevents loss of goodwill. Excellence in supply management results in better quality, customer service and channel performance [17]. For a retailer to excel in supply management, he needs to either meet the demand by replenishing the inventory or promote according to the available inventory. When the retailer chooses to replenish, it is necessary to evaluate the trade-off between the benefits brought by higher sales and the increased costs caused by promotion or holding inventory. In other words, a promotion plan needs to be coordinated with a proper procurement plan to meet the stimulated demand [18].

I present a model that integrates consumer search and purchase behaviour with the retailer's bidding (Cost-per-click scheme) and ordering decisions given that he has the opportunity to replenish.

Within a predetermined selling season, at the start of each time period, the retailer observes the inventory level and decides on the promotion level and the order quantity, which is delivered at the start of next time period. I consider the price to be exogenous to the model. The customer's willingness to pay is a function of the position of the firm (retailer's bid).

I show that the optimal policy is of multi-threshold type, wherein the promotion/ordering decision is determined by the inventory on hand. The managerial insights obtained from this study are that the optimal bid is increasing as the inventory on hand increases. Consequently, the order quantity within a constant bid decreases as the level of inventory increases. When higher bids have a positive influence on the demand generated, it is optimal to stock more inventory as described in the policy.

The sensitivity of customers to the position of advertisements impacts the thresholds of inventory. The desired level of inventory decreases as customers become more sensitive. This in turn affects the level of inventory beyond which no order is placed. The point beyond which no order is placed decreases as the sensitivity of the customers' increases. The retailers get minimum traffic despite of not bidding. Increase in sensitivity implies a higher cost of generating traffic. The retailer would bid even at low levels of inventory only when there is low customer sensitivity.

4. Optimal Portfolio of bids in sponsored search advertising: From Generic to Branded keywords

Online consumers include both buyers and information seekers [19–21]. Buyers purchase in the same period they visit whereas information seekers are the ones who return at a later point in time based on the memory. The terms a customer uses to initiate the search are called as “keywords” [22]. There are two types of keywords- generic and branded. For instance, a customer looking for perfumes might search using the generic term “perfumes”, and visit one of the sponsored links. The customer might not make a purchase and might choose to return to the same website at a later point in time. In order to revisit the site, the customer types a specific branded keyword like “White Diamonds perfume” [23]. As a firm advertises, the level of awareness amongst customers also increases. Due to recency effects, customers tend to remember only the latest visited websites [24]. In other words, the awareness which has been generated declines gradually over time. This memory effect of advertising enables the retailer to pulse his bids in a given selling horizon. Owing to this, an advertiser must choose his bids for the generic keyword and branded keyword optimally to maximise his profits.

Our model is grounded on the concept of arrivals through generic search improving arrivals through branded search [23]. The increase in level of awareness of customer base is accounted only through generic exposures. Branded exposures arise from those who are already aware of the product. Therefore, I captured the awareness generated only through generic exposures and incorporate a decay effect as time elapses.

A retailer who seeks to maximise profits must choose an optimal bid portfolio in terms of bid for generic keyword versus bid for branded keyword based on the prevailing level of awareness. In this chapter, I developed a model for a retailer employing the CPC (cost per click) pricing scheme which suggests the optimal bid for generic keyword and branded keyword in a given time period over a finite selling horizon. Price is exogenous to our model.

5. Conclusion

In my thesis, I have analyzed sponsored search advertising in three different contexts- (i) customer willingness to pay as a function of bid when there is fixed inventory available, (ii) customer willingness to pay as a function of bid when there is an opportunity for replenishment, and (iii) portfolio of bids for generic and branded keywords.

When the customer willingness to pay is a function of inventory on hand, in a fixed inventory scenario, my findings revealed that it is optimal for the retailer to use bid as a lever at lower inventories and price as a lever at higher inventories to enhance sales. However, when the customer willingness to pay is a function of bid, and has an opportunity to replenish, the optimal policy is of multi-threshold type, wherein the promotion/ordering decision is determined by the inventory on hand. The managerial insights obtained from this study are that the optimal bid is increasing as the inventory on hand increases. Consequently, the order quantity within a constant bid decreases as the level of inventory increases. When higher bids have a positive influence on the demand generated, it is optimal to stock more inventory as described in the policy.

6. References-

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