

Advanced Service Schemes for a Self-Interested Information Platform

(Extended Abstract)

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ABSTRACT

This paper deals with platforms that bring together agents and opportunities of the type in which they are interested (e.g., eCommerce platforms, used car bulletins and dating web sites). It shows that the platform can benefit from not necessarily listing all of the opportunities that it can potentially list, even if there is no marginal cost for listing any additional opportunity. Two important implications of this result are discussed and demonstrated. The first is that the platform should take into account the option to disclose different subsets of opportunities, whenever setting its expected-profit-maximizing service fee. The second is that from the platform's users point of view, it might turn out to be more beneficial to pay for the platform's service rather than get it for free (e.g., when the service is sponsored by ads), as the costly case is characterized by more favorable listings.

Categories and Subject Descriptors

I.2.11 [Artificial Intelligence]: Distributed Artificial Intelligence—*Multiagent Systems*

Keywords

E-commerce; Multi agents systems; Selective disclosure; Service schemes; Stackleberg game.

1. INTRODUCTION

In many two-sided multi-agent markets the number of opportunities potentially available to agents is substantial, however the agent needs to spend time and resources in locating these opportunities [2]. For example, a buyer who is interested in buying a specific product over the internet can potentially find this product in literally hundreds of online stores, most of which are unknown to her. This plethora of opportunities has been a catalyst for the emergence of platforms that serve as mediators and are used primarily as a point of contact for users and opportunities, saving users the need to invest their valuable resources in service or opportunity discovery [3].

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One of the most prominent questions in platforms research is how a platform should price its (information providing) services. Being a self-interested agent, the platform seeks to maximize its profit, taking into consideration its own information providing costs and the payments it receives. The payments can be received from any of the sides using the market (e.g., buyers, sellers), taking over some of their surplus from using the platform. Alternatively, payments can be received from external entities that may benefit from the activity taking place in the market (e.g., advertisers or repositories willing to buy user information collected by the platform). Prior work which considered the service-pricing question was taking the set of information listed by the platform to be given. In real-life, however, the platform is not limited to price-setting only but can control what information will be included in its listings[1].

In this paper we analyze richer service-terms-setting strategies for the platform, ones that do not take the set of opportunities to be presented to be fixed, but rather allow the platform to control what subset of these will be presented. For example, in cases where the platform's profit is fully based on advertisements scattered throughout the different pages, the platform can potentially benefit from omitting some of the more attractive opportunities from its listings. One important finding, of an existential nature, that results from the richer service-terms-setting strategies is that from the users' point of view, the free use of platforms, e.g., those that are sponsored by ads, is not necessarily the preferred choice. The preference of the "costly" alternative by the users is explained in our case by a more favorable listing. Furthermore, we demonstrate that for some settings the costly option is the dominant one both for the platform and for all users individually.

2. MODEL

The model builds on a standard platform-based one-sided search model of the kind commonly used in prior literature [4]. For exposition purposes, we adopt the procurement application domain terminology. The procurement setting considers a platform such as `alibaba.com`, `made-in-china.com`, and `gobizkorea.com` that brings together procurement agents (denoted "buyers" onwards) and sellers (typically small businesses worldwide).

Buyers are assumed to be self-interested fully-rational agents. In order to successfully complete their task, buyers need to locate sellers that sell the product in which they are inter-

ested and check their offers. In its most basic form, the model assumes that buyers are fully price-sensitive, hence the benefit in a seller’s offer is fully captured by its price attribute. The platform saves the buyers the trouble of locating sellers, however, as explained above, the price charged by each seller remains uncertain in the platform’s level. This uncertainty regarding the price q_i requested by seller s_i is represented by the probability distribution function $f_i(q_i)$, which is assumed to be known to the buyer, e.g., based on the accumulated history of the seller’s prices, seller’s characteristics and reputation (information that is potentially supplied by the platform). In order to obtain the price requested by seller s_i listed in the platform, the buyer needs to communicate with that seller, as explained above, incurring a cost c_i (e.g., cost of time). Since the focus of the paper is the individual platform, the other alternatives to the platform that are available to the user (e.g., using competing platforms or locating and querying sellers without the use of the platform) are modeled through the use of a private value, denoted R_b , expressed in terms of the alternative expense for purchasing the product not through the platform, as used in prior works.

Buyer’s Strategy.

The optimal strategy for the basic underlying search problem in our model can be found in classic economic search theory [5]. Here, a searcher is facing N opportunities, where each opportunity s_i is associated with a value q_i which is a priori unknown to her — only the distribution from which this value is drawn is known. The searcher’s goal is to maximize her expected revenue (or, as in our case, minimize her expected expense) while the true value of any opportunity i can be revealed for a cost c_i . The solution for the problem in its expected-expense-minimization form is as follows: The searcher should assign each opportunity i a reservation value (i.e., a threshold) R_i calculated as the solution for the following equation which represents the indifferent between querying for the value of opportunity i or exploiting the best value revealed so far:

$$c_i = \int_{q=0}^{R_i} (R_i - q) f_i(q) dq \quad (1)$$

The searcher should query the opportunities according to their reservation value, in ascending order, and terminate once the best (lowest) value found so far is lower than the reservation value of the next opportunity according to that order.

Platform.

The platform is assumed to be a self-interested agent, thus driven by expected-profit-maximization considerations. In this paper, we focus on two common service schemes, each offering different advantages and disadvantages to both the platform and the buyer:

- **Sponsored (“free”)** - the platform is sponsored by advertisers and gains a payment ad_{rev} for each ad presented to the buyer and the buyer gets to use the platform for free. The number of ads presented to a buyer is linear in the number of sellers queried by that buyer, as the latter measure is correlated with the amount of time the buyer spends using the platform and the number of pages it visits.

- **Per-click (“costly”)** - the buyer gets to see the properties of all listed sellers (price distribution and querying cost), however in order to query seller s_i (e.g., in order to reveal its identity and contact it) the buyer needs to pay the platform a payment c_c (in addition to incurring the appropriate cost c_i).

The buyer’s decision, if given the option to choose between the different schemes, should be either the “costly” Per-click or the “free” Sponsored. Between these two there is no dominance relationship from the buyer’s point of view. For example, consider a setting where there is one seller which, with a probability of 0.25, offers the product for free (e.g., has a promotion or offers a full rebate) and with a probability of 0.75 sells the product for the full price of 1. All other sellers are characterized by a uniform distribution of prices between 0 and 1, and there is no limit as to how many sellers can be included in the platform. Also assume $c_i = 0.02 \forall i$, $ad_{rev} = 0.01$ and $R_b = 0.3$. In this case, if using the Sponsored scheme, the platform will choose to exclude the first seller from its listings and keep only sellers of the other type. This is because when keeping only sellers of the second type, the reservation value used by the buyers is 0.2 (based on (1)), hence the expected number of sellers queried is 5 (results in expect profit of 0.05 for the platform) and the buyer’s expected expense is 0.2. If including the first seller, then that seller will be queried first (as its reservation value is 0.08) and the expected number of searches is 4.75. With the Per-click scheme, the buyer’s reservation value is $0.08 + 4c_c$ for the first seller and $\sqrt{2(0.02 + c_c)}$ for the others (according to (1)). The platform’s expected profit with the Per-click scheme will thus be maximized (taking into consideration the buyer’s private value) when including the first seller and charging $c_c = 0.025$, resulting in a total expected profit of 0.0875 (the alternative is to exclude the first seller and charge $c_c = 0.025$, resulting in expected profit of 0.0833). From the buyer’s point of view, being charged an additional cost of $c_c = 0.025$ for each query, however having the option to query the more favorable seller, results in an expected expense of 0.18 which is better than its expected expense with the Sponsored scheme (0.2). Interestingly, in this case, the platform’s expected profit when using $c_c = 0.025$ and including all sellers is 0.0875, which is greater than its expected profit when using the optimal subset while applying the Sponsored scheme (0.05).

The reverse preference is also possible. For example, if we simply remove from the above example the more favorable seller, the buyer’s preference turns to the Sponsored scheme.

3. REFERENCES

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