

Recommending trusted online auction sellers using social network analysis

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Abstract

The reputation system currently used by major auction sites to recommend sellers is overly simple and fails to take into account the collusive attempts by some sellers to fraudulently increase their own ratings. This paper presents a recommendation system that uses trading relationships to calculate level of recommendation for trusted online auction sellers. We demonstrate that network structures formed by transactional histories can be used to expose such underlying opportunistic collusive seller behaviors.

Taking a structural perspective by focusing on the relationships between traders rather than their attribute values, we use k -core and center weights algorithms, two social network indicators, to create a collaborative-based recommendation system that could suggest risks of collusion associated with an account. We tested this system against real world “blacklist” data published regularly in a leading auction site and found it able to screen out 76% of the blacklisted accounts. This system can provide warning several months ahead of officially released blacklists to help guard against possible seller collusion and can be incorporated into current reputation systems used to recommend trusted online auction sellers.

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1. Introduction

The reputation mechanism often used by the most popular online auction hosts is effectively a recommendation system for trusted sellers. The system is basically built on a simple mechanism, one that reports the cumulative result of bidder evaluations of the seller over time based on simple valence of positive, neutral or negative, along with communication comments. It makes use of a private ordering system to limit reviews by those who have traded with seller after the transaction has been completed. Successful private ordering systems in the past were based on the verifiability of geographic proximity and frequency of repeated transactions (Ellickson, 1991; McMillan & Woodruff, 2001), or the existence of guaranteed surrogates or resources in the vicin-

ity of transactions (Greif, 1989, 1993, 1994). However, the characteristics of online auction markets that allow registering with pseudonyms and multiple accounts create a mean to misbehave and avoid the consequences of a negative reputation. The current reputation mechanism is reported to have a disproportionately greater amount of positive feedback than negative or neutral feedbacks for fearing of revenge rating (Resnick & Zeckhauser, 2002). As a result, some studies have concluded that online reputation mechanisms have not been proven to be beneficial to the public (Bolton, Katok, & Ockenfels, 2004). Because online auction transaction are paid-up-front then delivered, the buyer is vulnerable to fraud. In fact, there is growing concern that online auction markets are becoming a major source of Internet frauds (Barnes, 2002; Freedman, 2002; Griggs, 2003; Warner, 2003; Wilke & Wingfield, 2003). The most severe cases reported, those involving multi-million dollar losses, often involve bidders who have been misled by the current oversimplified online auction

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inflated-reputation system (Chua, Wareham, & Robey, 2002; Han, 2003; Wilke & Wingfield, 2003).

There are three defects in the current online auction reputation system (Baron, 2001): (a) the information asymmetry among the sellers and buyers, (b) the moral hazard of misusing reputation credits for pseudonym on Internet, and (c) the tendency to not give negative feedback after completion of the transaction. Such defects create a market structure that makes it difficult to verify transactions, creates difficulties in recouping losses due to transaction frauds, and provides a low-risk setting for malicious sellers. The large increase in reported frauds in online auction sites has clouded this market. An improved information structure that can keep online auction reputation system at a low cost has become critical, if such an auction site is to be successful.

The approaches used by traditional recommendation systems, regardless whether they are content-based, collaborative, or hybrid of these two, are mostly used for recommending favored products and seldom used for evaluation of traders' reputation. In fact, those systems are subject to constraints as to their usefulness in evaluating traders' trustworthiness. The information asymmetry of the merchandise and accounts opened under pseudonyms affect the ability of content-based systems to profile sellers' accounts. The collaborative recommendation systems are widely used among popular auction sites. In this kind of systems, collective opinions are aggregated as one reputation score reflecting the trustworthiness of each trader's account. Here again, the given condition of anonymity and ease of maintaining multiple identities or collusive accounts increase the risk of relying on such a reputation score. The various heuristic-based collaborative recommendation systems are also limited by pseudonym and multiple identities on Internet and can only subscribe the information from transaction as inputs.

Several studies (Fawcett & Provost, 1997; Goldsborough, 2002; Li, Liu, Wu, & Zhang, 2006; Lucking-Reiley, Bryan, Prasad, & Reeves, 2001; Resnick, Kirwabara, Zeckhauser, & Friedman, 2000; Resnick & Zeckhauser, 2002; Shah, Joshi, Sureka, & Wurman, 2002; Snyder, 2000; Turban, 1997; Wang, Hidvégi, & Whinston, 2001a; Wheeler & Aitken, 2000) have focused on resolving such problem caused by the use of oversimplified recommendation mechanisms. Their solutions can be categorized into those (a) equilibrating the auction cost structures, or (b) introducing third party intermediators as appraiser to balance the information asymmetry benefits in current recommendation mechanism. However, those implementations have not been adopted by current auction houses for the additional cost and controversy of intermediary roles, and the concerns of losing the competitive niches in the highly elastic nature of online auction market.

In this study, we seek to improve current problematic reputation mechanisms so that it may serve as a more meaningful reputation merit indicator for the prospective traders and will integrate smoothly under the simple yet

well-accepted online auction reputation systems. To do this, we introduce the social network analysis approach to analyzing the underlying structure of the accumulated reputation score and its corresponding transactional network. We demonstrate how the social network measurements, k -core and center weights, can effectively filter out the malicious sellers. It cannot only serve as a meaningful and effective indicator for auction-goers to better appraise the risks associated with a reputation score, but also increase the cost of maliciously profiting from the information asymmetry by certain traders. To our knowledge, this study represents the first attempt of incorporating social network analysis information as part of the source of heuristic-collaborative recommendation for online auction reputation. Hereon, we refer to our study as a relationship-based recommendation mechanism for reputation evaluation.

We used real world blacklist data that were suspended fraudulent accounts collected from the largest online auction site in Taiwan, the Yahoo Taiwan Inc., as the dependent variables in our evaluation of the proposed recommendation mechanism. The developed mechanism successfully, in monthly average, identified 76% of the fraudulent accounts posted by the online auction host, also referred to as "blacklisted account(s)" hereafter. Of those identified fraudulent accounts, 75% of them are detected with leading time longer than 30 days.

This paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the construction of online auction transaction indicators and the possible use of these indicators to recommendation system and the discussion of the results of our findings. The last section concludes with limitations, future research and the final comments.

2. Review of the literature

This study focuses on resolving opportunistic abuse of online auction system's oversimplified reputation system. To establish a context and the target problems for this study, we first reviewed previous research devoted to online auctions and their recommendation systems, summarized findings and contributions to of research devoted to recommendation systems, and review select aspects of social network analysis, which is used to analyze user activity. Note that our discussion of recommendation systems is mostly under the context of reputation. Thus the term recommendation systems can be interchangeable with reputation system in this paper, unless specified otherwise.

2.1. Online auction and the defects of its recommendation system

The functions of the auction were identified as coordination, price determination, allocation, and a highly visible distribution mechanism (Klein, 1997). Online auctions reduce the barriers of traditional auction limitations, by

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