

New Trading Evaluation Mechanism on Incentive Design

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Abstract

This paper shows the effects of traders evaluation based computational mechanism design in electronic commerce. The proposes a new user evaluation methods based on multi-criteria based rating system. In the existing trading systems, most of them have user evaluation to help buyers/sellers decision making to trade. However, a user can never know where the potential trading partners did trade successfully based on his/her evaluation criteria. And also, some traders show the information, which are advantage on their trade on the e-commerce website. In some cases, sellers lose a chance to sell the item because of lack of their and their items information. Contrary, buyers sometimes cannot make a decision to choose trading partner because of poor webpage structure even though the seller is truthful trader. To solve these problems, we propose a new evaluation system based on multi-criteria evaluation and sellers trading history. We show 6 experiment results using our proposed mechanism the rest of paper.

Keywords: *Evaluation Systems, Mechanism Design, E-Commerce*

1. Introduction

A lot of academic researches on electronic commerce, recently, contribute to realize safe and rational trades. [1-3] and some theoretical research contributions have been appearing, and also some have been focusing on systems to be used practically [4-6]. Matsuo et al. proposed a new mechanism to reduce an incentive of untruthful bidding with theoretical analysis on trading in volume discount-based auctions [7-8]. In this few years, researches regarding trader's evaluation are becoming popular to make validity and reliability in evaluation systems. The contribution of evaluation mechanism researches can be applied to automatic trading support. Kobayashi *et al.*, proposed an effective evaluation model to evaluate users using trading relationship and its network. Online auction sites are regarded as network structures and confidential relationship is evaluated by the strength of network connected with each user. Also, Kobayashi et al conducted an experiment and analyzed the effectiveness of their proposed evaluation method, which is applied from web-page evaluation algorithm [9]. Usui pointed out that evaluation system gives a certain effect of market revitalization [11]. The market size becomes bigger, if the evaluation system is provided in the market. One of well-known auction sites eBay.com employs multiple attribute-based evaluation mechanism to enable users get useful information. The attributes include delivery speed, communication with buyer, and so on [22].

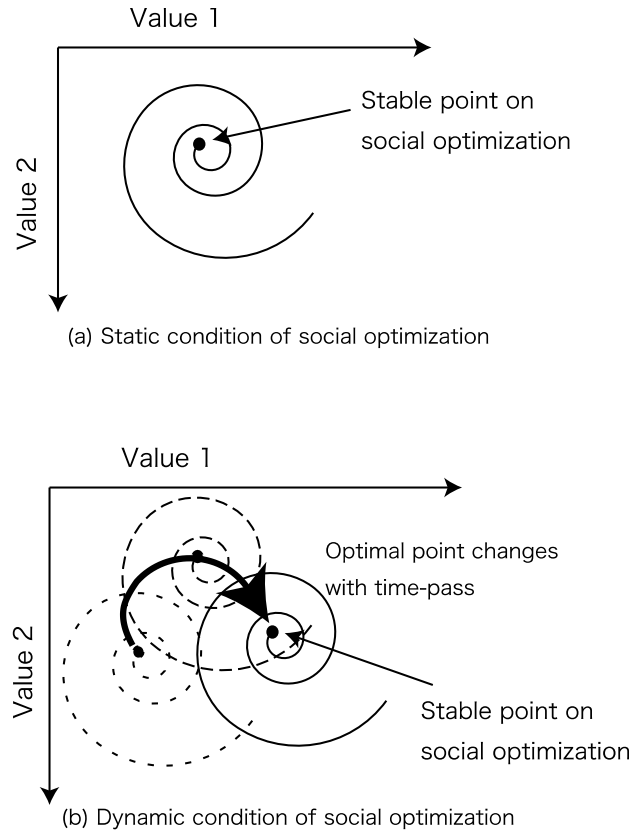


Figure 1. Fixed Point Changes Dynamically

However, in these systems, the evaluation between users is not objective and the trade makes an asymmetric information problem like that the amount of information in which buyer has are less than the information in which seller has. Thus, in this paper, we give a new concept of e-commerce evaluation method to reduce asymmetric and incomplete information between buyers and sellers. Former half of this paper, we give a preliminary discussion with survey about e-commerce features. Then, we give some explanations about our proposed concept in which sellers can define the evaluation criteria based on items and their confidence on trade. After that, we propose a new mechanism design that is implemented into the evaluation system in electronic commerce. Then, we give a result of simulation using our proposed mechanism. This paper is extended paper presented in [24] and provides some additional simulation and discussions. The contributions of our research are including to make a safe and secure e-commerce environment, reliable society in e-commerce, and to give a theory of mechanism design in evaluation system.

2. Preliminary Discussions

2.1. Existing Evaluation Systems

Yahoo! [12], Rakuten [13] and Bidders [14] are popular Internet auction sites in Japan. In their system, users can input their evaluation including total/synthetic evaluation and evaluation by free description. Users can know the latest result of evaluation and make

decision by viewing whether trading partner is active or not. Seller may gain evaluation score by many trades with same person, such as his/her friend. However, in a lot of e-auction systems, when a seller trades with same buyer, total score is not reflected after second trade. Namely, only new trades with different traders can be reflected in the total score. Buyer may deliberately give a bad/poor evaluation for sellers. In existing e-auction systems, a pair of seller and buyer evaluates by mutual evaluation. Thus, each trader takes care on evaluation. Although existing evaluation systems have these features, buyers can never perfect information about sellers and items with incomplete and asymmetric information. A lot of causes of criminal acts are set up by these problems on information.

2.2. Feature of Existing Evaluation Systems

There are roughly two types of synthetic evaluation system employing the point-addition scoring method like Yahoo! auctions and point-average scoring method like Rakuten [12] [13]. On the other hands, there are multiple attribute-based evaluation systems like eBay auctions, Bidders, and Wanted auctions [14, 22, 23]. The evaluation system in eBay employs four attributes-based five scoring evaluation model, including Item as described, Communication, Shipping time, and Shipping and handling charges. Each total score is calculated by average-rating method. However, the evaluated items are limited in eBay system, and it also is difficult to reduce the incomplete information for users. Further, criteria are not clarified and included in the system, and each buyer also has a different feeling and impression even in same trade process. The evaluation system in Wanted auctions includes both simple evaluation method and detailed evaluation method. Simple evaluation method is almost same with the evaluation process in Yahoo! auctions. Namely, synthetic evaluation and comments are input by traders. The detailed evaluation method has an advantage to reduce incomplete information for users. However, most of traders use the simple evaluation method. And also, the detailed evaluation method has a problem where the evaluation criteria is ambiguous. The result of evaluation is almost same with user evaluation system in eBay.

2.3. Incomplete Information

In the Internet-based auction, buyers view items information and sellers information based on only displayed information on the web browser. Buyers cannot perfectly know the actual information by the Internet until they receive purchased items. These situations put out incomplete information, such as every existing electronic commerce web site. On another hand, in an e-marketplace, differences of quantity and quality of information between sellers and buyers are huge issue for them. These situations put out the problem on asymmetric information. Web-based marketplace has more asymmetric information than actual marketplaces. In the actual marketplaces, buyers can view items from multiple aspects, sometimes touch and pick up them. Thus, they make sure the material, quality, size, and several other information. On the other hands, when users try to buy items on the electronic marketplace, they cannot touch and pick up items. Further, they just look at some pictures taken by sellers. Some sellers are good faith and honesty, but others may hide a scuff on the item and do not provide adverse information. It makes unfair trades. It is very important for buyers to be filled the gap of information between them and sellers. When there are above unfair issues on the trades, buyers sometimes fails their decision making to select items. This means that buyers' utilities are decreased by unfair information provision.

2.4. Computational Mechanism Design

To make an optimal society, mechanism design research is regarded as one of important research area in microeconomics research. Also, it is applied to make an optimal market, business model, and some other commercial activities. However, even though the invented mechanism is clear to solve the problem, the mechanism normally becomes complicated and complex. Although the mechanism has power to solve the problem, it is very difficult to apply to real world because citizens cannot easily understand the mechanism. In some cases, when the mechanism is employed in the marketplace, buyers and sellers need some pre-knowledge about economics and complicated trading procedure. In order to solve this problem, computational mechanism design is regarded as one of a promising field to make an optimal condition, even though sellers and buyers do not have good knowledge of economics. Also, in some situations, the optimal condition is dynamically change because the multiple types of agents join in the marketplace and they have a lot of properties. Mathematically, it is similar with dynamic systems like what the fixed point is changes with time pass in differential equation. Figure 1 shows the concept of the situation where the fixed point is changes. In the computational mechanism design in electronic commerce, the fixed point is monitored/predicted based on trading data, situation and condition, and all data used in past tradings.

3. Evaluation Mechanism

This section describes some conditions of the evaluation system and a mechanism employed by the system.

3.1. Conditions and Protocols

We show some conditions and a protocol of the evaluation system. Let $N = \{s_1, s_2, \dots, s_m, b_1, b_2, \dots, b_n\}$ be a set of sellers and buyers of the electronic commerce, where each s_j shows a seller and each b_i shows a buyer, and $A = \{a_1, a_2, \dots, a_k\}$ be a set of agents, which adjust the mechanism at each and calculate the evaluation. Hence, there are $N \hat{E} A$ players in the electronic commerce. The evaluation system has a set of evaluation items denoted by $E = \{e_1, \dots, e_l\}$ each item's upper $u_{e_i}(\hat{I} \hat{A})$ and lower bound $l_{e_i}(\hat{I} \hat{A})$ and a calculation method for computing the evaluation. We consider single seller and single buyer case for showing our protocol. First of all, the seller s chooses a set of appropriate evaluation items $E^s \subseteq E$ for an own selling goods. Second the buyer b is able to evaluate the seller s and input it to the evaluation system when the buyer b took the goods. Also the evaluation system puts on among time from a transaction termination time to giving scores for each evaluation item by the buyer b . The buyer b scores to each evaluation item e^t given by the seller s among the value from upper u_{e^t} to lower bound l_{e^t} subjectively, that is, whether each evaluation item e^t influence to make a decision of purchasing in evaluation phase. In this phase, the evaluation system gives a weight to each evaluation item e^t which shows believability of the item. The weight is calculated by an average score of every past buyers' evaluation scores.

3.2. Evaluation Mechanism

Our objective of making an evaluation mechanism is to have an incentive for the seller to open more correct information of his/herself. The mechanism employs credit history method for not only providing useful subjective information to the buyers but also providing some objective information like a transaction result. The credit history is, generally, a credit record institution for credit card users of USA. The credit history works the following scheme: (1) When the credit card user uses the credit card continuously or does not fall behind in his/her payment, the credit history point is increasing. (2) When the credit card user falls his/her payment or does not use his/her credit card continuously, the credit history point is decreasing. Our mechanism uses this scheme, and we describe our mechanism as follows.

[Mechanism 1] Each seller s_j is given his/her evaluation by each agent a_i and buyer b_i .

[Mechanism 2] The buyer b_i is able to report an impression of the goods compared with before purchasing and after receiving the goods. Also the buyer is able to report a difference between a process written on the webpage and actual process.

[Mechanism 3] The interval of purchasing time and evaluation reporting time is able to influence the seller s_j 's rating, particularly, it is able to influence the evaluation of transportation time.

[Mechanism 4] The agent a_i gives some additional evaluation points to the seller s_j by number of evaluation items indicated by the seller s_j .

[Mechanism 5] The system is able to give some weight for separating evaluation items between important and not in the transaction before the buyer b_i scores the evaluation.

[Mechanism 6] The system evaluates some similar evaluation items, which is not specify in this trading, depending on the case of trading.

[Mechanism 7] The agent a_i adjusts the evaluation point by using credit history.

[Mechanism 8] The agent a_i calculates a total evaluation point of the seller s_j .

4. Efficiency of the Mechanism

We evaluate our above mechanisms' efficiency by some computational experiences, simulations and incentive analyses. In this section we show some fundamental observations. Mechanism 1 in our mechanism is able to control that the seller s_j increases own total evaluation value by making fictional buyer, where every buyers and sellers do not know how to calculate the total evaluation value. Mechanism 2 requires fairness to the buyer's evaluation. In the existing electronic commerce, the buyer report ambiguous evaluation, the evaluation is not fair unless the impression of the seller is not same among the buyers. Mechanism 3 controls a reliability of the evaluation items. If the buyer scores to the evaluation items after a long time, then the impression of the purchased goods is decreasing. Hence, the evaluation system employs the mechanism 3 as a penalty for delaying evaluation of the buyer. Mechanism 4 works for the sellers to encourage opening information. It means the evaluation system has an incentive that the seller provides more evaluation items to the buyers, when the system announces the

additional point is given by the number of opening information. Also if the administrator of the electronic commerce evaluates the number of evaluation items is too many for the buyer, the system restricts the evaluation items such that it satisfies a maximum total additional point. This mechanism has another advantage. The most hopeful seller's strategy of increasing his/her point is to increase the evaluation items and to improve his/her weak point. This mechanism has a function that the seller tries to improve his/her weak point in this mean. Mechanism 5 is able to eliminate idle evaluation items for the selling goods. For example, if the seller choices "Is this goods fresh?" as one of evaluation item in the sale category, the goods is already categorized Sale, therefore the seller's choice is idle evaluation in this case. This problem is able to be solved by the buyer put a weight on the important evaluation item. Mechanism 6 controls that the seller choices a lot of redundant evaluation items for increasing his/her evaluation value. For example, suppose that the seller describes some foreign countries on the introduction of the goods and this goods is actually made by a foreign country. Then the two evaluation items "Does the introduction accord with actual goods?" and "Is the goods made by domestic?" are redundant. Mechanism 7 means that the system evaluates the seller who gets a positive point continuously. That is an evaluation of continuously application. We consider that the total point of the seller is only calculated by the average value given by the buyers. Even if the seller is evaluated by negative evaluation after he/she got many positive evaluation, the high level positive evaluation lacquers the negative evaluation. This mechanism requires that a high level seller tries to trade maturely. It means that the mechanism provides a negative incentive for false trading. Mechanism 8 tries not to occur a disadvantage for the sellers by the agent changes the total evaluation value with respect to each market character by using some control value. We have been confirmed that the ratio of successful trading is changed significantly by types of buyers in the experience which verifies the effectiveness of decision making of purchasing by considering the evaluation value of the seller.

5. Incentive Making

5.1. Evaluation from the System by Information Disclosure

Our proposed model is based on number of disclosure of information. Multiple attributes to evaluate are prepared and a seller selects attributes based on his/her strengths. If he/she is good at packing, he/she can choose the "Package" as the evaluated attribute. On the other hand, if he/she does not want to disclose his weakness, he/she can omit the attribute to be evaluated. To design a desirable mechanism in evaluation, we set a control value based on number of information disclosure. When a seller changes five attributes from four attributes to be evaluated, the system gives an incentive points to the seller. Namely, if the seller discloses more attributes, the incentive points are given in proportion. Thus, he/she sets up a lot of attributes to get many incentive points. And also, incomplete information reduce from the shopping site. However, if he/she does so, he/she needs to be careful in each activity on a trade if a seller provides an item's information by pictures and explanation, a risk on trade is decreased [20, 21].

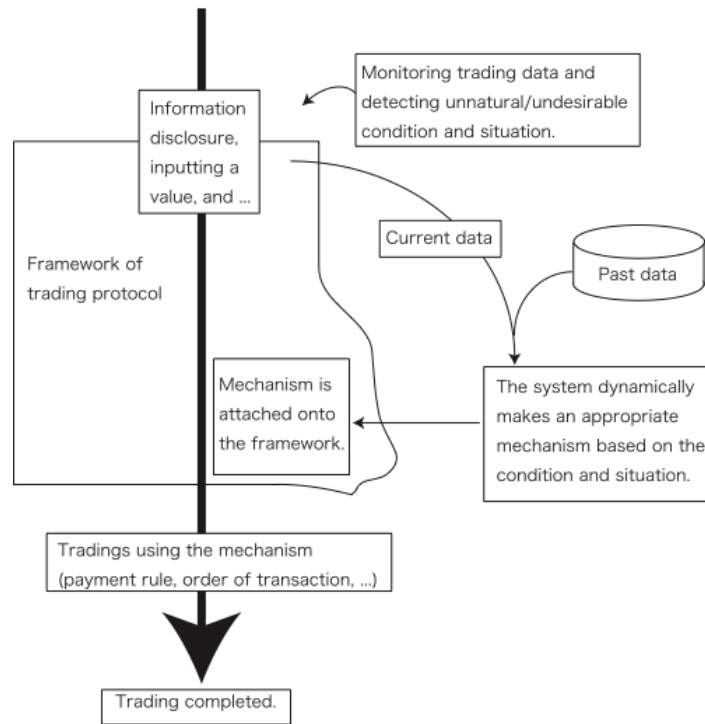


Figure 2. Computational Mechanism Design

5.2. Evaluation from the System by Cumulative Extra Point

Here, we define an experience value based on the cumulative number of trades for each seller. In existing evaluation systems, the score/rating of evaluation is calculated simple cumulative trading experience. For example, when a seller has 30 positive rating without any negative rating and he/she gets a positive rating in a subsequent trade, his/her score becomes 31 rating. However, we propose an appreciate model for outstanding sellers. The outline of the model is that the system gives an extra point for a seller who continues a lot of trading without negative rating from buyers. On the other hands, once he/she gets a negative point, the cumulative number goes back to the start. For example, when a seller has cumulative 100 positive rating without any negative rating and he/she gets a positive rating in a subsequent trade, the system give some extra score automatically. Thus, the marketplace positions outstanding sellers apart from the rest.

6. Experiments

In this section, we show the result of experiments regarding the rating of seller evaluation after tradings. The purpose of this experiment is the effects of evaluation from the system. In this experiment, extra points based on the number of disclosed information and credit history are considered. Rate of extra point is changed and the effect of trading condition is investigated. From this experiment, the result is used to make an optimal condition of tradings. Namely, the goal and future work of this research is to adjust the appropriate rate of extra point. Figure 2 shows the process of

tradings and making a mechanism. Our experiment is basic contribution in a mechanism design phase.

6.1. Setting

Normally, the number of evaluation criteria should be discussed based on the number of categories and items. However, simply, in this experiment, we assume that the number of evaluation criteria is between 1 to 10. We assume the buyers can give evaluation rating between 1 to 5. Extra point from the system is added between 1 to 5 based on number of disclosed information and credit history. When the system gives the maximum point to the seller who has maximum point from buyers, his total point becomes 10. In this experiment, we give the following rule when the buyer make a decision to buy the item: (1) Item's price, (2) Amount of disclosed information (item information, shipping service, and sales), and (3) Evaluation information (rating from past buyers and extra point based on number of evaluation criteria and credit history from the system).

Regarding the item's price, each buyer has a budget to buy the item. When the price is higher than the budget, he/she never makes a decision to buy the item.

Regarding the number of information disclosure, the amount of description and photo and several other information are considered. Particularly, in our experiment, we employ the shipping and sales in addition to item information. Each seller has characteristics about the e-commerce management. In our experiment, we assume three information disclosure levels. Because there are three attributes of information disclosure (item information, shipping service, and sales), there are twenty seven combinations of levels of information disclosure. If the level of information disclosure is high (namely, a lot of information is shown), such sellers have a big chance to be chosen by seller.

Regarding the evaluation information, in our experiment, each extra point of number of evaluation criteria and credit history is given between 1 to 3. When number of criteria is between 1 and 2, the extra point is 0. When number of criteria is between 3 and 4, the extra point is 1.5. When number of criteria is over 5, the extra point is 3. Regarding extra point by the credit history, when the seller has positive rating from buyers in recent 11 tradings, he/she gets 0.3 extra point. The example of extra point on credit history is shown in the Table I. If the total extra point becomes over 5, the actual extra point to be given is 5.

Each buyer has a decision making rule to choose a seller and to buy the item. Even though there are a lot of sellers whose condition is met to buy the item, the buyer choose only one appropriate seller.

After purchasing, each buyer evaluates the seller and gives a rating. Evaluation value given by the buyer is based on the difference between the item's price and his/her budget. Also, It is related with the factor of decision making. If the difference between the budget and item's price becomes positively large, evaluation value becomes high trend. Also, the amount of information disclosure is large, evaluation value becomes high trend. On other cases, buyers give negative rating on some probabilities.

6.2. Result of Experiments

In this paper, we show experiment results of the six cases of credit history. In the marketplace, two hundred buyers and nine sellers exist. Each seller is dealing in thirty items. When the items are sold out, he/she finishes his/her sales. The result of experiment

is shown in Figures 3(Number of evaluation criteria is 1 and credit history is 1), 4(Number of evaluation criteria is 1 and credit history is 2), 5(Number of evaluation criteria is 2 and credit history is 1), 6(Number of evaluation criteria is 2 and credit history is 2), 7(Number of evaluation criteria is 3 and credit history is 1), and 8(Number of evaluation criteria is 3 and credit history is 2). Vertical axis shows the average of total evaluation value and horizontal axis shows the process of trades (maximum 30).

Nine sellers are shown as respectively $\{s_1, \dots, s_{10}\}$. Right description in the graph shows the number of evaluation criteria (number of information disclosure) defined at random.

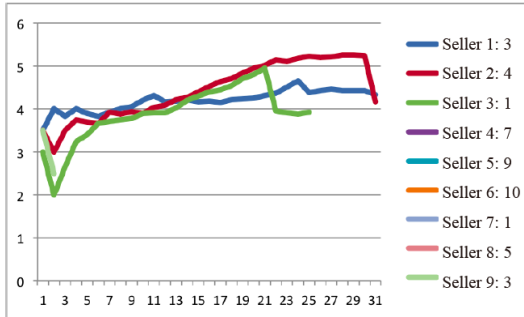


Figure 3. 1 Criteria and 1 Credit History

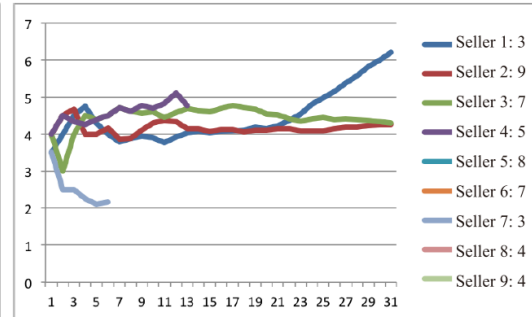


Figure 4. 1 Criteria and 2 Credit History

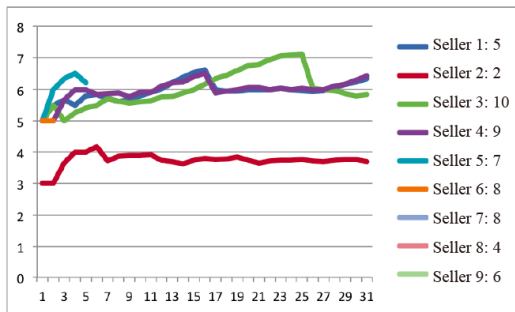


Figure 5. 2 Criteria and 1 Credit History

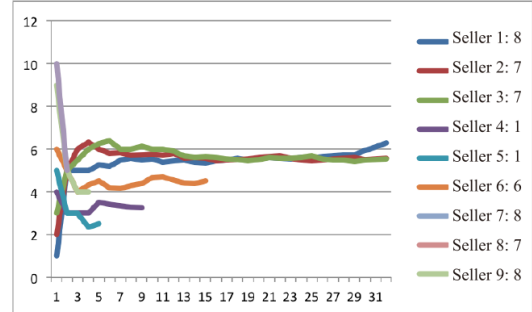


Figure 6. 2 Criteria and 2 Credit History

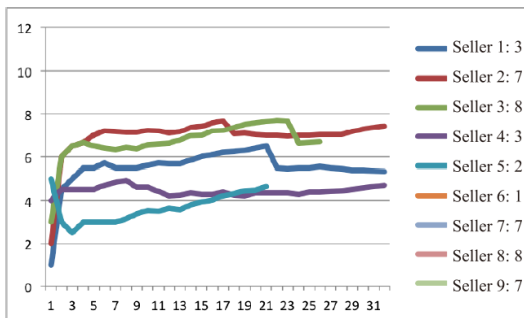


Figure 7. 3 Criteria and 1 Credit History

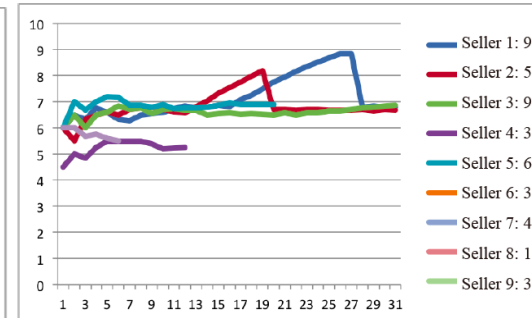


Figure 8. 3 Criteria and 2 Credit History

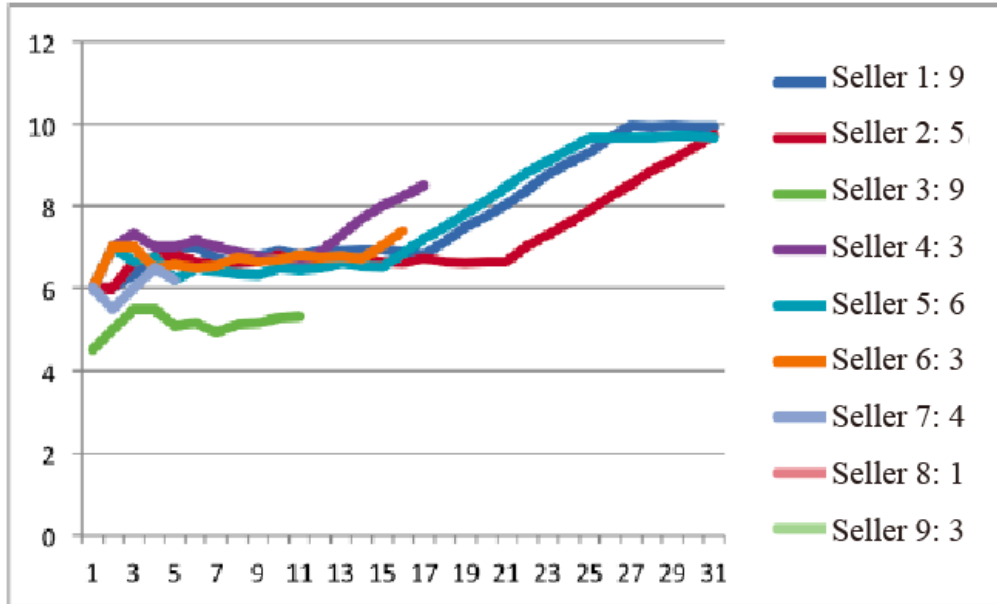


Figure 9. Additional Simulation on 3 Criteria and 3 Credit History

7. Discussion

7.1. Trader Selection

When the number of criteria and credit history is less, effects of selection of sellers are not prominently active shown Figures 3-5. Particularly, in the case where number of credit history is less shown in Figures 3, 5, and 7, the sellers selection is not done well. Although only three sellers 1, 2, and 4 can continue to trade until step 31, some sellers like seller 7, 8, and 9 who provide a lot of information are get ousted from the market. Showing the result of experiments in Figures 6 and 8, most of sellers providing poor information are ousted from the market. From this result, when the number of criteria and credit history is increased, our proposed mechanism makes well-effects to our objects. In Figure 9, we show an additional result of experiments where the number of criteria is 3 and number of credit history is 3. The effects are clearly-further shown comparing with the above 6 experiments. However, if the number of them are increased more and more to make effects, the trading mechanism and process may be complicated and users may confuse to trade in such e-marketplace. When the condition of number of criteria and credit history is set, the e-commerce manager carefully choose the condition based on his/her benefits.

7.2. Related Work

Researches on the evaluation system in online auction system are very popular and a lot of contributions are published [16]. Kobayashi analyzed the evaluation mechanism on the Internet auctions by considering as a network structure, that is, the relationship is constructed between buyers and sellers [15]. The contribution proposes a new evaluation model of network structure instead of the evaluation on trades by sellers and buyers. Further, in the contribution [16], he implemented the evaluation system with the evaluation algorithm of web page. It also analyzed through the experiments to make sure of effectiveness.

Ming analyzed the evaluation method of online auction to take in exponential smoothing [17]. It analyzed to avoid the cheating because a bad evaluation yields large impact on seller's evaluation to give a lot of weight the last evaluation. It is a large effect to have a lot of weight when seller resorts to cheating for buyer in trade. Ito analyzed the Internet auction protocol to permit the Pareto efficient distribution [19]. It shows that the protocol can admeasure according to goods quality made a honest declaration by specialist when there are a lot of asymmetric information and some specialist in the Internet auction.

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