Study of Credit Evaluation Algorithm Based on Iterative Principle of Unified Platform

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Abstract. Because retail consumers are difficult to authenticate, they are difficult to manage, it leads the credit management of C2C e-commerce is very difficult. At present, most C2C e-commerce transactions are considered too simple in the credit evaluation algorithm, it can't really reflect the integrity of the user. In this paper proposes the credit evaluation algorithm based on iterative principle bases on transaction history, on the basis of considering the transaction amount, the transaction time and the credibility of the users, with the method of iterative calculation, give full consideration to the effects of time of credit for the success of the deal to provide reliable basis, it can effectively distinguish malicious users and integrity users, thus reducing the credit fraud behavior, such as improving the security of C2C e-commerce.

Keywords—credit evaluation algorithm; iterative principle; iterative calculation; unified platform

1. The Necessity of Credit Evaluation Algorithm based on Iterative Principle of Unified Platform

1.1. The Background of C2C E-commerce Credit Evaluation

C2C e-commerce is one of the most serious credit problems in several e-commerce models, the main reason is the difficulty of the authentication and management of the retail business, causes buyer's seller credit asymmetry problem. In turn, there are many credit evaluation problems for the c2c e-commerce, classification of commercial credit, fraudulent trading, money laundering, and so on, so it is important to strengthen credit evaluation management. At present, the existing credit evaluation mechanism mainly considers the service quality factor of the transaction, there are some researches on C2C e-commerce credit evaluation model, reference the transaction time and transaction amount, such factors as the user types, but factor analysis in some single, credit evaluation method is simple. People put credit on the public platform largely. At present, there are four typical credit modes in China's e-commerce industry, namely the intermediary mode, the guarantor mode, the website operation mode and the entrusted authorization mode. No matter which model is the retail consumer credit on the site or financial institutions, but in fact trading process is most directly credit considerations is retail consumer credit rating value, so should be called for C2C e-commerce sites should improve the credit evaluation system, especially the credit evaluation algorithm optimization [1].
1.2. Evaluation Factors
The Internet is open and virtual, and credit has become an important factor hindering the development of trading on internet. The existing situation, some trust evaluation systems guarantee the security and fairness of network transactions to some extent, but there are still some deficiencies. Most trust evaluation models of C2C e-commerce use simple cumulative credit evaluation algorithms to calculate users' reputation. Although credit crisis is reduced and confidence in online transactions is enhanced, there are still some problems in evaluation rules and methods. The evaluation model is established by referring to the following factors. [2]

1.2.1. Two-way real-name authentication
Anonymous trading not only brings convenience to online trading but also brings risks, so how to confirm the authenticity of the identity of the trader is very important to online trading. At present, most C2C e-commerce websites pay more attention to the authentication of sellers, and the unilateral identity authentication mechanism is not perfect, which is unfair and nourishes the soil for fraudulent behaviors. Moreover, most of the authentication mechanisms are too simple, causing many loopholes in online transactions. For example, some sellers accumulate high credibility through small transactions, and then use the credibility to carry out large fraudulent transactions, which cannot be restricted in the simple credit evaluation mechanism and seriously affects the reliability of online transactions. This paper proposes a credit model of two-way real-name authentication, that is, identity authentication is required for both seller and buyer.

1.2.2. Trade time
In the existing C2C e-commerce websites, credibility is the result of accumulated transaction time, so there is no difference in the ratio of length of time in the calculation of credibility. But in fact, some of the early transactions no longer reflect the creditworthiness of the current transactions. However, in such a credibility calculation mechanism, the influence of transaction duration on credibility is the same, so it is inevitable that some sellers make use of the early accumulation of reference factors, and the credibility can earn users in the current transaction without guaranteeing the transaction quality. As a result, the impact of trading on current creditworthiness should be diminished the longer it is traded. In the credit model of this paper, the transaction time is the reference factor to calculate the credit value, and the longer the transaction time is from the credit calculation time, the smaller the credit value of this transaction occupies in the evaluation, and vice versa.

1.2.3. Transaction value
After investigation, it is found that the current trading website amount credit evaluation algorithm does not consider the transaction value factor. One dollar and one hundred dollars have equal opportunities for credit evaluation. Although the user's reputation should not be measured by the transaction value, some users use small transactions to accumulate credibility. After gaining a high reputation, they ignore the product quality in the transaction or even conduct fraudulent transactions. It can be seen that transaction value should have a certain weight in the calculation of credibility, and this weight should increase with the increase of transaction value.

1.2.4. Type of evaluation user
The users in the evaluation system include: normal evaluation users, malicious evaluation users, no evaluation users, false self-evaluation users and return evaluation users. The evaluation of normal evaluation users is the closest to the truth. Malicious evaluation users are dissatisfied with the transaction due to the difference between the transaction value and their ideal transaction value, or due to logistics and other factors, so they vent their anger through malicious evaluation. It can be seen that the evaluation of malicious evaluation users should not be completely included in the calculation of credibility. There are also many users who prefer not to make evaluations, and most of the current evaluation systems equate users without evaluation with good evaluation calculation, but this is
obviously not true. There are also a lot of sellers buy and sell their own evaluation, this is more fraudulent behavior. In addition, there are some users who need to return goods for various reasons, and the evaluation is usually just a random reason. Obviously, the authenticity of the same evaluation by different users is different, and the weight of the evaluation should be different in the calculation of credibility. And this user category and in the evaluation, no sign, but you can through the evaluation of the assessment of user information and comparing the average, the closer the higher the credibility of the mean, in order to identify the evaluation of user categories, and treat the difference between different users evaluation of value, the assessment of the value evaluated by users and the average distance to determine. [3]

1.3. The Necessity of Credit Evaluation Algorithm based on Iterative Principle of Unified platform
The credit evaluation of C2C e-commerce is to pursue true and reliable, the factor of consideration must be many, and the algorithm also can be more complicated. In addition, there is a large number of users of the credit evaluation of the website, which brings problems to the website's timely and timely access to the latest user credit rating. Moreover, the past credit evaluation focuses on the factors that affect the credit degree, and does not excavate the accuracy of the algorithm itself. Based on the iterative principle, the credit evaluation algorithm utilizes the characteristics of the iterative method, simplifies a complex calculation to be a simple calculation, which greatly improves the calculation speed, another feature of iterative method is the accuracy of the calculation, therefore, it can greatly improve the credit evaluation speed and its reliability by establishing the iterative theory in the credit evaluation algorithm. Many credit problems in transactions are caused by the credit inequality between the two parties in C2C e-commerce. The credit inequality between the two parties is reflected in the asymmetry of commodity information mastered by both parties on the one hand, and the information control between the two parties by the trading platform on the other hand. That is, the seller has all the commodity information, while the buyer can only understand the commodity situation with the help of evaluation, pictures and other information. In order to attract consumers, the trading platform only supervises the seller, while the buyer supervises loosely. This brings a lot of problems to the transaction, the key to solve this problem is to strengthen the supervision and certification of buyers and sellers. [4]

2. Principle of Credit Evaluation based on Iterative Principle

2.1. Introduction to the Iteration Principle
Iterative method is also called tossing and turning, it's the process of constantly using the old value of the variable to push the new value, it is a method to solve the problem approximate solution by using recursive formula or cyclic algorithm. For example, using the relational formula, can calculate from $x_0$ to $x_1$, $x_2$, …… The way to approximate the root $x^*$ of $x = f(x)$, and according to the relationship $x_{k+1} = x_k + d_k (k=0, 1, 2, 3, ……)$ the approximate solution to the linear algebraic equation $ax=b$, all are iterative method. In general, we use the recursive relation $x_{k+1} = \Psi_k(x_k, x_{k-1}, …, x_0)$ $(k=0, 1, 2, 3, ……)$ to solve the problem of $x^*$ by constructing sequence $\{x_k\}$, the method is called iterative method, $\Psi_k$ is called an iterative operator or an iterative function, $\{x_k\}$ is the iteration sequence. If $x_k$ exists the limitation $\lim_{k \to \infty} \|x_k - x^*\| = 0$, the iterative sequence converges. If there is the formula

$$C_p = \lim_{k \to \infty} \|x_{k+1} - x^*\|/\|x_k - x^*\|^p (C_i < 1)$$

If there is $1 \leq p < \infty$, it is said that the iterative sequence has a p - order convergence rate for $x^*$ or the p order converges. If for all iterative sequence $\{x_k\}$ produced by iterative function $\Psi_k$ converges to $\{x_k\}$, if upper formulas are hold, the iterative method is called the convergence of the p order to $x^*$ .

To determine the positive integer m, iterative algorithm $x_{k+1} = \Psi_k(x_k, x_{k-1}, …, x_0)$ $(k=0, 1, 2, 3, ……)$ is called the m-step iterative method, When $m=1$, it is called one-step iterative method or progressive approximation method, which is the most commonly used iterative algorithm. When using the m-step
iterative method, a given m initial approximation is required. When using m step iteration method, I need to give m initial approximate values \( x_0, x_1, \ldots, x - m + 1 \). When using the m-step iterative method, it is required to give m initial approximation values \( x_0, x_1, \ldots, x - m + 1 \). If \( \Psi \) has nothing to do with the \( k \), called constant lap the generation method. All the constant iterative methods can be reduced to this form. When step constant iterative method \( x_{k+1} = \Psi_k(x_k) \) converges to \( x^\star \), \( x^\star \) is the solution of equations \( x = \Psi(x) \).

The following basic convergence theorems for single-step iterative method are:

**Theorem 1:** In solution \( x^\star \) the neighborhood within \( x \) \( \Psi(x) \) is continuously different able, the spectral radius of \( \Psi(x) \) less than 1. Then, when the initial approximation \( x_0 \) and \( x^\star \) are sufficiently close, the single-step constant iteration method converge for \( x \).

**Theorem 2:** In area \( S = \{x \mid \|x - x_0\| \leq r\} \) or within \( \Psi(x) \) meet the conditions:

\[
\|\Psi(x) - \Psi(y)\| \leq q\|x - y\|, \quad x, y \in S, \quad \text{and} \|x_0 - \Psi(x_0)\| \leq (1-q)r
\]

if \( 0 < q < 1 \), then \( x = \Psi(x) \) there is a unique solution \( x^\star \) in \( S \), the single step constant iteration converges to \( x \), and there is estimation:

\[
\|x_k - x^\star\| \leq \frac{q^n}{1-q} \|x_0 - \varphi(x_0)\|
\]

### 2.2. Credit Evaluation Algorithm Function

Weighted evaluation algorithm is used as the model base for iterative calculation, the basic principle of this algorithm is [5].

In this model there are some purchasers, respectively as: \( p_1, p_2, \ldots, p_m \), and purchaser \( p_i \) has \( n \) times trading with the seller, a certain transaction may be described with a quintuple: \( (p_i, K, W_j, M_j, R_j) \). \( p_i \) is the number of purchaser, \( W_j \) is the User type weights in this trading, it is an influence factor of user creditworthiness, \( M_j \) is the transaction value, \( R_j \) is the evaluation value of purchaser in this transaction. At present, the reference factors of online trading platform's reputation evaluation are not perfect, and the calculation mechanism is too single. To this end, there are six grades of evaluation estimate in this model, respectively as: +2 points is six stars, +1 point is five stars, 0 point is four stars, -1 point is three stars, -2 points is two stars, no evaluation is \( (m - m_0)/m \) points, by this way it can obtain a true evaluation value. Suppose that the evaluation value of purchaser \( P_i \) is \( q_i \), there is the following formula:

\[
q_i = \sum_{j=1}^{n} M_j R_j (1 + (j - 1)\partial)(T_j - T_0)/\sum_{j=1}^{n} M_j (T_j - T_0)
\]  

\( T_j \) is the time of a curtain trading, \( T_0 \) is the original time of trading, \( (T_j - T_0) \) is the delta-T, the delta-T is longer and lower credibility weight the time has. The \( M_j \) is trading value, it is an important credibility evaluation factor. Through the transaction amount factor, the weight of large transactions and small transactions in the evaluation is treated differently, so as to reduce the weight of small transactions in the credit evaluation and reduce the risk of large transactions. Variables in the formula is sellers credit value before evaluation, the variable iteration as new credit calculation, the dynamic calculation the user's credibility. It can be seen that the calculation formula of credibility refers to a variety of factors summarized in the previous summary, and dynamically adjusts the weight of each factor in the evaluation, rather than a single current evaluation. Moreover, through two-way real-name authentication, both sellers and buyers are calculated for credibility. This kind of credit calculation mechanism more truly reflects the user's credit situation and guarantees the overall reliability of online transactions.

By formula (2), the credit value of both buyer and seller can be calculated:

\[
P = \sum_{i=1}^{n} P_i W_i
\]
\[ W_i = \begin{cases} (1-|P_i - P'|) & |P_i - P'| \leq \theta \\ (1-|P_i - P'|)\sigma & |P_i - P'| > \theta \end{cases} \] (3)

\[ P' = \frac{\sum_{i=1}^{n} P_i}{n} \quad (P' \text{ – average credit of seller}) \] (4)

In formula (3) variable \( \theta \) is allowable variation, in order to weaken the single influence of each variable in the credit calculation and avoid the illegal operation of the evaluation gap of the single variable by the seller or the buyer, the deviation in the evaluation of the single variable is allowed as long as it is within the allowable range of the deviation. So set a variable \( \sigma \) as attenuation coefficient, used to weaken the weight of a single variable evaluation. Through the analysis of transaction history data, the values of allowable deviation and attenuation coefficient are obtained.

2.3. Iterative Method to Calculate Credit Evaluation Value

Using iterative algorithm to solve problems, we need to do the following three aspects.

(1) Determine iteration variables. In the case of iterative algorithm processing, at least one variable that is continuously, indirectly or indirectly, the new value is recursively introduced by the old value, which is the iteration variable. The iteration variable in this algorithm is the original credit value. Select the original credit value of algorithm iteration variable, because the original credit value the most visually reflect credit history, according to the current generated by the new credit data, including trade time, trade amount, the evaluation information such as user type, iterate, generated by the current credit value considering the history of the credit data and into the new credit data, very objective.

(2) Establish an iterative relationship. An iterative relationship refers to the formula (or relationship) of how to derive the next value from the previous value of a variable. The establishment of iterative relations is the key to deal with iterative problems, you can usually do this using a recursive or backward push.

(3) Control the iterative process. The iterative process cannot be repeated indefinitely. The control of an iterative process can usually be divided into two situations: One is that the number of iterations required is a determined value that can be calculated; the other is that the number of iterations required cannot be determined, and the conditions for the completion of the iterative process need to be further analyzed.

The above formula (2) and formula (4) are the solution of the credit and average credit degree of the transaction, it’s going to use the iterative formula here:

\[ P'_{k} = (P_{k} + P'_{k-1})/2 \] (5)

\[ P' = \frac{P_n}{n} \] (6)

Iteration variables are \( P_k \) and \( P'_{k-1} \), \( P \cdot \) can be calculated using the formula (2). \( P'_{k-1} \) is the average value of the credit before this calculation, can be calculated using the formula (4). The formula (5) is the iterative relationship. Number of iterations is to evaluate the number of users. Here, the formula (5) and (6) are used to deal with the theorem 1, hypothesizes \( n=1 \). \( P_0=0.001 \) (The user's initial credit rating takes a smaller value that is well below percent one). Let's figure out one iteration \( P_1 \), \( P_2 \ldots \ldots \), \( P_n \), Solution space \( \{P_1 \ P_2 \ldots \ldots \ P_n\} \) there is formula (5) in the domain converges to \( P^* \). And the accuracy of convergence is controlled by theorem 2, Namely hypothesizes in the area \( S=\{p|\|p-P_0\|\leq r\} \Psi(p) \) meet the conditions.

\[ \|\Psi(p)-\Psi(q)\|\leq e\|p-q\|,\ p,q\in S,\text{and}\|p-\Psi(p_0)\|\leq(1-e)r \]

In there, \( 0<e<1 \), then \( p=\Psi(p) \) existence unique solution \( P^* \) in \( S \), the single step constant iteration
method convergences $P^*$ for $p$ convergence, and there are estimations:

$$\|P_k - P_x\| \leq e^x/(1-e) \|P_0 - \Psi(P_0)\|$$

The convergence process is shown in Figure 1, the convergence curve reflects the trend of credit.

![Credit convergence chart](image)

**Figure 1. Credit convergence chart**

2.4. **Unified Platform Design Characteristics of the Two-way Real-name Authentication**

Two-way real-name authentication provides a unified authentication platform for buyers and sellers. Its functions are as follows:

(1) User consistency. That is to say, the platform does not distinguish the identity of users is seller or buyer, or some users are both buyers and sellers, the authentication of users is the comprehensive authentication of the two identities.

(2) Unity of certification. In order to keep track of online transactions and avoid users taking advantage of gaps between different websites to make illegal operations, the platform has unified authentication for all users of online transactions, and the authentication result is also the credential for users to conduct transactions on various websites.

(3) Uniqueness of certification. The root of this authentication system is identity information, because the uniqueness of identity information guarantees the uniqueness of an authentication ID, and users conduct online transactions through a unique user number. (Suggestion: The server obtains ID card information from the public security network)

(4) Unity of online transaction management. It realizes the unified management of all website users’ credit information.

(5) Based on DNS system. The platform is constructed based on DNS system.

Two-way real-name authentication, if it is to perform the above functions, requires a unified platform rather than individual websites. Obviously such platforms are not just social. In order to more need of national supervision. The unified management also brings about many problems and puts forward higher requirements for the platform:

(1) Strong certification ability.

(2) The tracking ability of the whole network is not the transaction trace of a single website, but the transaction trace of the whole network, which makes the evaluation more comprehensive and real.

(3) The huge amount of platform processing requires high performance of the system.

To sum up, DNS server is selected as the authentication platform based on the system proposed in this paper. DNS server has mature technology and stable operation. Relying on the primary platform, it reduces the technical cost and risk of system authentication, and makes it possible to unify online authentication in the whole network. Under the support of DNS server, the authentication platform in the model proposed in this paper has the following characteristics.

(1) There is no need for independent website management, grafting on DNS is convenient for implementation, and the management and development cost is small.

(2) both the buyer and the seller, as long as it is the first time the number of registered users need to the DNS system, which can identify and need DNS system with public security net for networking, at
the time of authentication ID information of the inspection, if the information is correct, give users a
transaction ID, it will be the only users online transaction documents, users in any web site to deal
with this ID credit calculation and cumulative, according to the number of users in each site for credit
management, truly unified management.

(3) A child table will be added to all levels of the DNS server IP and domain table, to record all
users information based on this IP.

2.5. Model structures
Credit Evaluation Algorithm Based on Iterative Principle of unified platform in this paper, combined
with bidirectional real-name authentication and weighted credit evaluation technology, the bi-
directional real-name authentication scheme can fundamentally solve the credit problem of online
transactions. In Figure 2, the transaction value, transaction time, and the type of user evaluated will all
serve as reference factors for the credibility calculation, which makes the evaluation much
comprehensive. The evaluation system platform will intuitively reflect the changes of users' reputation
in the way of the trend chart of credibility.

![Credit evaluation process of C2C e-commerce site](image)

Figure 2. Credit evaluation process of C2C e-commerce site

2.6 Simulation Experiment

2.6.1 Experiment Process
The payment link in the transaction first needs the authentication of the user, and the user can only trade
as one identity, or buyer or seller. If the user ID already exists, its identity in the transaction will be
checked. If it is already the identity of the buyer, it will be refused to become the identity of the seller,
and vice versa. We have chosen to conduct a credibility analysis of a seller's transactions over a period
of 200 days. The simulation parameters of the model are shown in Table 1, information of no.1 user and
no.2 user is shown in Table 2 and Table 3.
Table 1. The simulation parameters

| model parameters | description                               | value |
|------------------|-------------------------------------------|-------|
| $\hat{\partial}$ | evaluation coefficient of returned customer | 0.3   |
| $\theta$         | allowable deviation                       | 0.24  |
| $\sigma$         | decay factor                              | 0.7   |

Table 2. The NO.1 buyer’s information of transactions

| trade times | 1 | 2 | 3 | 4 | 5 |
|-------------|---|---|---|---|---|
| trade time (day) | 50 | 100 | 120 | 150 | 200 |
| trade value (yuan) | 20 | 200 | 300 | 80 | 89.740 |
| user evaluation | +1 | +2 | -1 | null | 0 |

Table 3. The NO.2 buyer’s information of transactions

| trade times | 1 | 2 | 3 | 4 | 5 |
|-------------|---|---|---|---|---|
| trade time (day) | 20 | 40 | 60 | 80 | 100 |
| trade value (yuan) | 20 | 70 | 200 | 250 | 300 |
| user evaluation | +1 | +2 | -1 | null | -2 |

The trade time is the time interval someone trade and the first time trade.

By formula (1) we will have the credibility calculation value of seller coming from buyer one and buyer two as 0.7, -3.45. By formula (4) we will have the mean value of credibility as -1.56. By formula (3) we will have the seller’s type weight as -1.14, -1.032. Buyer 1 and buyer 2 evaluations are all beyond the allowable deviation value, it shows the user type may be malicious evaluation user, so the evaluation needs to be weakened to reduce the important of the evaluation. Formula (2) will give the comprehensive credit of seller within one hundred days as 3.20.

If we select a continuous nine periods of 100 days, respectively calculate the seller credit for every 100 days as 3.12, 2.86, 3.14, 2.56, 2.54, 2.81, 2.61, 2.67, 2.94, and then draw out the seller credit trend chart within ten periods of one hundred days (refer to Figure 3). It can be seen from the credit trend chart that the seller’s credibility is downtrend at present, the user should carefully consider whether trading with the seller.
2.6.2 Experiment Result Analysis

This paper proposes a two-way real-name authentication mechanism, and on this basis carries out the weighted calculation of credibility. This authentication mechanism can realize the unified management of buyer and seller, so that users can follow the track of online transactions on the whole network and truly achieve effective supervision. At the same time, the calculation of credibility integrates multiple factors and computes in an iterative way. Each factor is not static but dynamic, which makes the calculation more realistic and reliable. The model established in this paper can solve the credit problem of C2C e-commerce in a fundamental sense.

3. Summed up

Credit is affected by many factors, there are many algorithms for evaluating credit evaluation factors in various aspects, in this article established the credit evaluation based on iterative algorithm, and also on the premise of considering many evaluation factors, the evaluation of relative only to the past into the evaluation of the current iteration, shrink each factor in the evaluation of low, mainly to see as a whole, is a relatively intelligent evaluation model of self-correcting.

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