

Establishment of new e-commerce data processing model based on dynamic fuzzy theory

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Abstract

Compared to companies engaged in traditional commerce, sports e-commerce companies are involved with more kinds of business data, encounter higher demands on data processing, and experience more complex data processing methods. In this dissertation, dynamic fuzzification method is adopted to improve the original evaluation method for weight quota distribution, optimize representation method of membership degree, and minimize influences of human factors. Results show that data processing can reflect dynamic development trend of assessment objectives and are more appropriate than other methods for research on this subject.

Key words: DYNAMIC FUZZY THEORY; SPORTS E-COMMERCE; DATA PROCESSING

Introduction

At present, e-commerce becomes the emphasis of China's economic development. After the rise of e-commerce, an increasing number of enterprises start to trade online. Hence, massive backstage data about customers and plentiful transaction records are accumulated on e-commerce websites [1]. These resources contain vast quantities of information. Studying e-commerce data mining owns certain social value. In e-commerce, the study on application data mining algorithm and model in customer identification, customer segmentation and customer retention greatly drives application of data mining in this field. Besides, classification and rating can be made through analyzing customers' repaying capability and credit so as to reduce the credit risk and improve capital use efficiency.

Currently, researchers mainly utilize relevant algorithms of data mining to establish market-based customer segmentation model. For instance, Jaesoo Kim et al. study application of neural network algorithm in tourism customer segmentation and discuss advantages of neural network in customer segmentation [2]. Guo Yunhua proposes customer classification based on fuzzy clustering analysis algorithm [3]. Chen Bocheng puts forward algorithm model of self-organizing mapping neural network and researches its application in customer segmentation [4]. Fei Xianju utilizes Apriori algorithm in association rules to carry out correlation analysis of customer information database and studies its application in customer acquisition [5]. But many problems existing in data mining in e-commerce will still emerge as information technologies appear continuously. Especially due to complexity, diversity and numerous characteristics of e-

commerce data, e-commerce website data processing is a multi-layer and multi-factor comprehensive problem. It is hard to analyze many indicators with classical mathematical methods. At present, there are many common evaluation models, such as analytic hierarchy process, Kantor Rule and DEA method [6]. Although there are rich methods, these methods fail to focus on dynamic fuzzy phenomena of commerce websites. They only consider fuzziness, but ignore the dynamic nature.

This paper adopts dynamic fuzzy method to improve original evaluation method of quota allocation of weight, optimize membership expression method and reduce influence of human factors. Through data processing results, it can also reflect dynamic development trend of evaluation target. It is not suitable for research of this topic.

Mathematical model of dynamic fuzzy integrated evaluation

Dynamic fuzzy set is a method expressing dynamic fuzzy data, and it is short for DFS. It combines data dynamic nature and fuzzy set theory and further expand and extent them [6, 7].

U is defined as:

$$(\overleftarrow{A}, \overrightarrow{A}): (\overleftarrow{U}, \overrightarrow{U}) \rightarrow [0,1] \times [\leftarrow, \rightarrow], (u, \vec{u}) \mapsto (\overleftarrow{A}(u), \overrightarrow{A}(u)) \quad (1)$$

It is recorded as $(\overleftarrow{A}, \overrightarrow{A}) = \overleftarrow{A} \text{ or } \overrightarrow{A}$, and then $(\overleftarrow{A}, \overrightarrow{A})$ is considered as dynamic fuzzy set (DFS) on $(\overleftarrow{U}, \overrightarrow{U})$; and $\mu(\overleftarrow{A}(u), \overrightarrow{A}(u))$ is considered as membership degree of membership function to $(\overleftarrow{A}, \overrightarrow{A})$.

When the domain of discourse U is $\{(u_1, \vec{u}_1), (u_2, \vec{u}_2), \dots, (u_n, \vec{u}_n)\}$, the dynamic fuzzy set is always expressed as:

$$(\overleftarrow{A}, \overrightarrow{A}) = \mu(\overleftarrow{A}(u_1), \overrightarrow{A}(u_1)) / (u_1, \vec{u}_1) + \mu(\overleftarrow{A}(u_2), \overrightarrow{A}(u_2)) / (u_2, \vec{u}_2) + \dots + \mu(\overleftarrow{A}(u_n), \overrightarrow{A}(u_n)) / (u_n, \vec{u}_n) \quad (2)$$

In Formula (2), $\mu(\overleftarrow{A}(u_i), \overrightarrow{A}(u_i)) / (u_i, \vec{u}_i)$ means one-to-one corresponding relation between

element (u_i, \vec{u}_i) and its membership degree but not obtaining of fraction value in arithmetic operation. Similarly, “+” means a kind of connection relation connecting all $\mu(\overleftarrow{A}(u_i), \overrightarrow{A}(u_i)) / (u_i, \vec{u}_i)$ as a whole for easy expression and it does not mean summation in arithmetic operation.

Any number $a \in [0,1]$ can dynamically fuzzify a as:

$$a = \overset{DF}{(a, a)} \text{ or } a = \overset{DF}{a \text{ or } a} \quad (3)$$

$$\max(a, a) = a \quad (4)$$

$$\min(a, a) = a \quad (5)$$

In this way, development and change trend of the state of a can be expressed in an intuitive way.

Each factor in the integrated evaluation problem has a certain evaluation score. However, many problems cannot be evaluated simply by one score. Some problem may be evaluated by different people according to the same evaluation factor, resulting in different results. In this case, the evaluation result is not a certain number any more but one fuzzy concept expressed by words. Moreover, this concept is not static but dynamic. In order to obtain accurate evaluation results, dynamic fuzzy integrated evaluation method shall be used.

Dynamic fuzzy theory methods

Experimental subject

One Wuhan-based sports e-commerce company named AA which is committed to leisure food is selected as experimental subject of this study, and dynamic fuzzy theory method is used to process commerce data of the company.

Evaluation procedures

According to dynamic fuzzy integrated evaluation model introduced in the above context, this evaluation is conducted in accordance with the following procedures:

Indicators of user’s satisfaction to sports e-commerce websites shall be set in accordance with characteristics and physical truth of business operation. In this study, 3 first-class indicators and 9 second-class indicators are used to evaluate users’ satisfaction as shown in table 1.

Table 1. Indicators of evaluation on users’ satisfaction to sports e-commerce websites

First-class Factor	First-class Weight	Second-class Factor	Second-class Weight
Condition of goods	0.3	Category of goods	0.3
		Taste of goods	0.3
		Price of goods	0.4
Consumption	0.4	Purchase state	0.2
		Payment convenience	0.4

		Payment safety	0.4
Service quality	0.3	Pre-sales consultation	0.3
		After-sales guarantee	0.3
		Return of goods and change of goods	0.4

Multi-level evaluation level is confirmed according to evaluation objects and environment. The evaluation level shall be confirmed in accordance with relevant basic principles, such as principles of combining instructiveness, rationality, individuality and generality as well as operational principle, which shall fully reflect scientificity of evaluation results. Classification of evaluation level shall be convenient for uses to understand and select evaluation indicators. Both too detailed and too rough classifications are unfavorable for comprehensive results of the evaluation. In this system, single evaluation result and comprehensive evaluation results on sports e-commerce websites by customers are classified into 5 levels including very good, good, general, bad and very bad levels. At the same time, the evaluation results have two dynamic change direction, namely ascending direction (\rightarrow) and descending direction (\leftarrow).

This evaluation is designed to understand whole conditions of AA Company's sports e-commerce website from the perspective of users. Therefore, all indicators shall be judged by users through designed questionnaires. Moreover, statistical data in relation to AA Company's annual sales volume and profits and revenue shall be collected for evaluation.

In accordance with research goals, a survey is conducted to customers in this study in terms of three first-class indicators and nine second-class indicators: the former indicators include condition, consumption condition and service quality in relation to goods; and the latter includes category, taste and price, consumption condition, payment convenience, payment safety, pre-sales consultation, after-sales guarantee, return and change in relation to goods. Based on this, it is aimed at understanding consumers' evaluation on AA Company in an all-round way.

By utilizing random sampling method, 400 consumers of AA Company were selected randomly from June 10th to June 20th, 2012. They were required to evaluate their

satisfaction to the company from three first-class indicators and nine second-class indicators. Among them, 382 consumers supported this survey with questionnaire recovering ratio of 95.5%. In terms of the questionnaires recovered, 32 questionnaires are filled with halfhearted, inexact and incomplete information. Therefore, after these questionnaires are eliminated, there are 350 effective questionnaires with effectiveness ratio of 87.5%.

The analysis of evaluation result

The evaluation results of overall satisfaction

Obtaining all the data of the consumers in different indexes, counting the consent number of people in the individual reviews of each index levels, and then converting them into a consent ratio, so that to make it as membership function of single factor evaluation matrix. Subsequently, according to the previously proposed calculation method to calculate the overall degree of membership and then get the overall and individual evaluation results.

Table 2 is the evaluation of AA Company's overall satisfaction condition.

Table 2. Evaluation result of AA Company's overall satisfaction

Overall satisfaction	Goods condition	Consumption situation	Service quality
$\vec{63.27}$	$\vec{63.13}$	$\vec{62.16}$	$\vec{65.23}$

Analyzing the data in table 9, it can be concluded as follows:

(1) Through the above evaluation results, it seen that the final dynamic fuzzy evaluation value of AA Company's consumer satisfaction is $\vec{63.27}$, which illustrates its whole situation is "general", but the development trend is in a better direction. This shows that the company is continuing making great efforts to provide customers with better consumption experience, improve service, and at the same time which is worth the users' expectations.

(2) To the three first class indexes' scores, they reflex the grade is "general". It is these three aspects' scores reflect "general" made this company's overall satisfaction of consumers did

not reach the grade of “good”, among which the score of service quality is the highest shows that it has a better user experience feeling. The scores of consumption situation and goods condition are in the second grade, and the two scores only have a little difference.

(3) From the development trend, in the three first class indexes, only the development trend of goods condition is in a better direction, and development trends of the consumption situation and service quality are in bad indirections. This shows that the reason why the overall condition is in a better direction, due to goods condition’s development trends. But there is a downward trend in consumption situation and service quality, which is worth noting.

The evaluation result of goods condition

Table 3 is the evaluation result of goods condition.

Table 3. Evaluation result of goods condition

Goods satisfaction	Goods classification	Goods flavor	Goods prize
$\vec{63.13}$	$\vec{63.59}$	$\vec{65.60}$	$\vec{65.13}$

Analyzing the data in table 3, it can be concluded as follows:

For the goods condition, its final dynamic fuzzy evaluation value is $\vec{63.13}$, from its contained three second class indexes, the goods classification and goods flavors’ scores are quite the same and the score of goods price is slightly lower. But in the three indexes, only goods classification’s development trend is in a better direction, and the goods flavor and goods price are in bad direction of development trend. This shows that the users feel that the company’s goods quantity is gradually increasing, but at the same time, the goods flavors did not get better and the goods price also did not fulfill consumers’ satisfaction.

The evaluation result of consumption situation

Table 4 is the evaluation result of consumption situation.

Table 4. Evaluation result of consumption situation

Consumption satisfaction	Purchase condition	Consumption convenience	Consumption Safety
$\vec{62.16}$	$\vec{65.72}$	$\vec{66.81}$	$\vec{61.03}$

Analyzing the data in table 4, it can be concluded as follows:

(1) The evaluation value of consumption situation reflects its grade is “general”. In its three subordinate indexes, the consumption convenience’s score is the highest, to reach a good level. This shows that it gets the affirmation of the users. The second is the purchase condition whose grade also reflects to be “general”, and the lowest score is the consumption safety.

(2) On the development trend, the satisfaction of consumption situation’s development trend is going to have a bad direction. In its three subordinate indexes, only the consumption convenience has a better direction of development trend, and other two indexes both have bad directions of development trend. This shows the users felt that the purchase situation and consumer safety both have a downward trend.

The evaluation result of service quality

Table 5 is the evaluation result of service quality.

Table 5. Evaluation result of service quality

Service satisfaction	Pre-sales consultation	After-sales service	Refunding and exchanging
$\vec{65.23}$	$\vec{67.21}$	$\vec{64.17}$	$\vec{61.23}$

Analyzing the data in table 5, it can be concluded as follows:

(1) In the service quality, its evaluation score reflects as “general” grade. In its three subordinate indexes, the score of pre-sales consultation is the highest, followed by after-sales service, and the worst is refunding and exchanging. This shows that in the refunding and exchanging, this company is not doing enough good, which still needs to improve.

(2) In the development trend, only the development trend of after-sales service is in a better direction, which shows that this company has begun to focus on fostering customer loyalty, improving customers’ second purchase rate. But for the rest of the indexes, their development trends all have bad directions. It needs to be noted that the importance of product status for consumers is obvious. However, if the service cannot keep up, the consumers’ consultations and doubts cannot be dealt timely, or consumer feedback channels are not enough, or mishandling consumers’ feedbacks, which will eventually affect the consumer’s overall satisfaction.

Improvement suggestions

Through the analysis of previous evaluation result, the improvement suggestions to this company's sports e-commerce website are summarized as follows:

(1) At the same time to increase the goods classification, it should take the enhancement of goods flavor and rationalization of goods price into account.

(2) Strengthening the construction of website, improving customers purchase rate, and providing convenience for consumers' payment, to ensure the security of transactions.

(3) Focusing on users' feedback, timely and effectively handling users' comments and suggestions. Focusing on improving the quality of pre-sales consultation and after-sales service, and for the customers need to refund and exchange, it should be more positive and patient.

In order to know the rationality and effectiveness of the above suggestions, after five months for AA company adopts the suggestions and rectify, it should conduct a survey towards customers once again to find out the evaluation results of this commerce company's satisfaction. Table 6 is the evaluation of AA Company's overall satisfaction condition after implementing rectification.

Table 6. Evaluation of AA Company's overall satisfaction condition after implementing rectification

Overall satisfaction	Goods condition	Consumption situation	Service quality
$\vec{64.35}$	$\vec{64.21}$	$\leftarrow 63.01$	$\vec{66.41}$

Analyzing the data in table 6, it can be concluded as follows:

(1) The final dynamic fuzzy evaluation value for AA Company's consumer satisfaction is $\vec{64.35}$, which has a great improvement compared with the values before improving, and its development trend is in a better direction.

(2) From the scores of its three first class indexes, the scores of the three indexes have varying degrees of improvement compared to the scores before improving. The service quality's development is in a better direction which indicates the improvement measures have a great advantage to improve service satisfaction.

Table 7 is the evaluation result of goods condition after implementing rectification.

Table 7. Evaluation result of goods condition after implementing rectification

Goods satisfaction	Good classification	Goods flavor	Good price
$\vec{64.21}$	$\vec{63.79}$	$\leftarrow 65.83$	$\vec{65.56}$

Analyzing the data in table 7, it can be concluded as follows:

In the goods condition, its final dynamic fuzzy evaluation value is $\vec{64.21}$ which has a promotion compared with the value before improving. The scores of its three second class indexes all have improved, and the development trend of goods price is in a better direction. This indicates that the rectification measures have a greater impact on good prices, towards goods flavor, it also has some effects, but not obvious. Table 8 is the evaluation result of consumption situation after rectifying.

Table 8. Evaluation result of consumption situation after rectifying

Consumption satisfaction	Purchase condition	Consumption convenience	Consumption safety
$\leftarrow 63.01$	$\vec{65.92}$	$\vec{67.21}$	$\leftarrow 61.29$

Analyzing the data in table 8, it can be concluded as follows:

Consumption situation's overall satisfaction and its three second class indexes (purchase condition, consumption convenience, consumption safety) have varying degree of improvement, among which the purchase condition has an obviously improvement and its improvement trend is from getting worse to getting better. This shows that the improvement measures are helpful to improve the consumption situation. Table 9 is the evaluation result of service quality after rectification.

Table 9. Evaluation result of service quality after rectification

Service satisfaction	Pre-sales consultation	After-sales service	Refunding and exchanging
$\leftarrow 66.41$	$\leftarrow 67.73$	$\vec{64.77}$	$\vec{61.81}$

Analyzing the data in table 9, it can be concluded as follows:

After rectification, the overall satisfaction of service quality is $\leftarrow 66.41$, which has a larger increase compared to that before rectification. The

scores for the three second class indexes all have a certain level of growth, and the development of refunding and exchanging is from getting worse to continuously getting better. This indicated that consumers express satisfaction towards this company in the effort of refunding and exchanging.

Conclusions

Sports e-commerce is greatly different from traditional commerce in terms of data category, data processing method and data processing model. In this study, dynamic fuzzy theory-based processing method is used to process data of evaluation on consumers' satisfaction to sports e-commerce websites. Then some problems existing in the Company are found out, and based on the problem suggestions on rectification are put forward. The rectification results demonstrate that these suggestions are effective and they are beneficial to improving consumers' satisfaction to this sports e-commerce company.

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