Evaluation of Sports E-commerce Service Quality Based on SERVQUAL Model

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Received 1 September 2014, www.cmnt.lv

Abstract

E-commerce development has progressed increasingly in recent years. A service quality evaluation index system should be established under the background of modern information technology to better understand e-commerce services and effectively supervise and manage e-commerce. Sports online shopping (e-commerce) is regarded as an example in this study to analyze the relevant factors that influence e-commerce service quality through the SERVQUAL model according to the current situation of e-commerce service quality. A comprehensive and scientific evaluation system is constructed through fuzzy theory and analytic hierarchy process. An instance analysis of e-commerce service is also conducted with the aforementioned model. Evaluation results are obtained, and corresponding improvement strategies are proposed.

Keywords: SERVQUAL model, FAHP, Factor analysis, Sports e-commerce, Service quality evaluation

1 Introduction

Chinese e-commerce exhibits rapid development as the popularity of electronic computer technology increases further [1]. Its users and scale expand continuously. Novel commercial models are gradually changing people's consumption concept. Many merchants and consumers turn to the network sales model from the traditional marketing channel. E-commerce competition has begun to shift its focus from "price" to "service quality" in recent years [2]. Meanwhile, the unavailability of e-commerce products exhibits a significant difference with the traditional sales mode. Service quality is vital because of the virtuality of networks. Service quality imposes direct effects on commodity sales and customers' vital interests [3]. Sports commodities as new modern products gradually develop and have become popular with the Olympic Games and the increase in people's living standards [4]. On this basis, e-commerce service quality in recent years is investigated in this study.

The SERVQUAL model is one of the significant theories to study service quality. It has been analyzed by numerous scholars [5]. Currently, the studies of Chinese and foreign scholars on e-commerce service quality evaluation index systems mainly focus on four aspects [6]. First, the SERVQUAL scale is introduced in the e-commerce field for an adaptation test. Second, the SERVQUAL scale is modified according to network service features. Third, a multi-dimension service quality evaluation system is believed to be necessary in the overall evaluation of e-commerce service quality. Fourth, a differential scale is set up based on different modes to measure e-commerce service quality and enhance its applicability. Although both Chinese and foreign scholars have presented certain research achievements, no final conclusions exist for the constitutional dimensions of e-commerce service quality evaluation systems and measurement indexes of each dimension [7]. In addition, a recognized e-commerce service quality evaluation systematic framework has not been established yet [8].

On this basis, fuzzy analytic hierarchy process (FAHP) is applied in this study. Sports e-commerce service quality is regarded as an example to construct an evaluation model by selecting suitable dimension indexes through factor analysis [9]. Sample verification and analysis are performed to provide a reference value and theoretical support for e-commerce service quality supervision and management. The findings of this research contribute to the understanding of e-commerce service conditions and further development of e-commerce.

2 Theory summaries

Factor analysis was mainly adopted in this study to select appropriate sports e-commerce service quality evaluation indexes based on the SERVQUAL model [10]. A service quality evaluation model was developed through FAHP, and the model was analyzed.

2.1 SERVQUAL MODEL

Many researchers in the service field have begun to stress the necessity of service quality evaluation since the 1980s. Since then, a series of research results have been presented, where the SERVQUAL model is the most typical method. SERVQUAL, the abbreviation of "service quality," is a new service quality evaluation system developed by American marketing experts A [11]. Parasuraman, Zeithaml, and Berry in the 1980s according to total quality management theory. The core of this model is "the gap of service quality,"

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i.e., "service quality depends on the degree of differences between the service level users perceive and the service level users expect." Therefore, it is also called the "expectation–perception" model. Users' expectation is a prerequisite to the implementation of high-quality services. The key to providing superior services is to exceed users' expected value (see Fig. 1). SERVQUAL divides service quality into five levels: tangible facilities, reliability, responsiveness, trust, and empathy. Each level is subdivided into several questions. The expected, actually perceived, and minimum acceptable values provided by users to each question are graded through a questionnaire. Relevant specific factors are confirmed. The score of service quality is then obtained through questionnaire survey, grading by customers, and comprehensive calculation. This model has been widely accepted and adopted by managers and scholars in the past 10 years. Studies show that SERVQUAL can be applied to measure information system service quality. SERVQUAL is an effective tool to evaluate service quality and decide on actions to improve service quality.

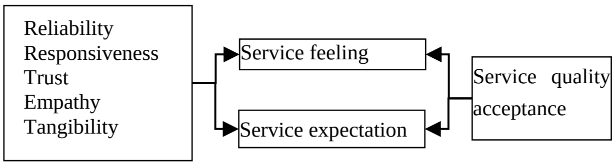

FIGURE 1 SERVQUAL model.

2.2 FACTOR ANALYSIS AND FUZZY COMPREHENSIVE EVALUATION

Thur Stone proposed factor analysis in 1931. The basic purpose of factor analysis is to apply a few factors to describe many indexes, analyze the correlation among these factors, and classify several related variables into the same category. Each category of variables is one of the factors (a factor is an unspecific variable and cannot be observed). Several factors are utilized to reflect most of the information on the item to be evaluated. Factor analysis is a type of model analysis that seeks a relevant common factor. It constructs several common factors with specific significance based on the main components and analyzes and explains the original variables based on these common factors to determine the relationship among the original variables.

Fuzzy comprehensive evaluation is an FAHP. It is a comprehensive evaluation analysis method that combines fuzzy theory and analytic hierarchy process (AHP). Such method occupies a very important position in multi-target or multi-factor analysis. It is one of the analytical methods widely adopted in the academic circle. It fuzzily quantifies qualitative factors that cannot be confirmed. Thus, it overcomes the inaccurate measurement disadvantage of AHP and establishes a priority judging matrix for weight calculation and result evaluation. Manoharan et al. discussed customer demand weight in the process of quality function deployment (QFD) and confirmed it with FAHP; they introduced a fuzzy consistent matrix in AHP and confirmed customer demand weight in QFD by establishing a fuzzy consistent matrix. Given that a fuzzy consistent matrix complies with the psychological feature in the decision-making process, the accuracy of confirming customer demand weight can be improved by using a fuzzy matrix.

3 Establishment of a fuzzy comprehensive evaluation model for sports e-commerce service quality evaluation

3.1 SPORTS E-COMMERCE SERVICE QUALITY EVALUATION SYSTEM

The SERVQUAL model is based on difference theory, i.e., the difference between customers' expected service quality and the quality of actual service gained by customers. The model evaluates the quality of different services received by customers through five dimensions. The research of numerous scholars is combined with actual situations to finally confirm the five dimensions of sports e-commerce service quality evaluation system: tangibility, usability, reliability, responsiveness, and security. Tangibility mainly refers to the degree of providing similar personal experience for untouchable network products in the consumption process. Usability mainly refers to the difficulty and speed involved in entering the website and using website services. Reliability refers to the performance degree of the website in terms of service delivery commitment. Responsiveness refers to the website's efficiency in terms of problem handling and replying. Security mainly refers to website security and the degree of protecting consumers' privacy (Figure 2).

The computational formula of the expectation–perception relationship is

$$SQ = \sum_{k=1}^{n} W_k \sum_{i=1}^{m} \left(\overline{P}_i - \overline{E}_i\right), \left(k = 1,2,\cdots,n; i = 1,2,\cdots,m\right) \quad (1)$$

Where W_k is the weight value of the k^{th} quality evaluation dimension of e-commerce, Pi is the expected value of service quality perceived by the i^{th} customer, and Ei is the expected value of service quality expected by the i^{th} customer.

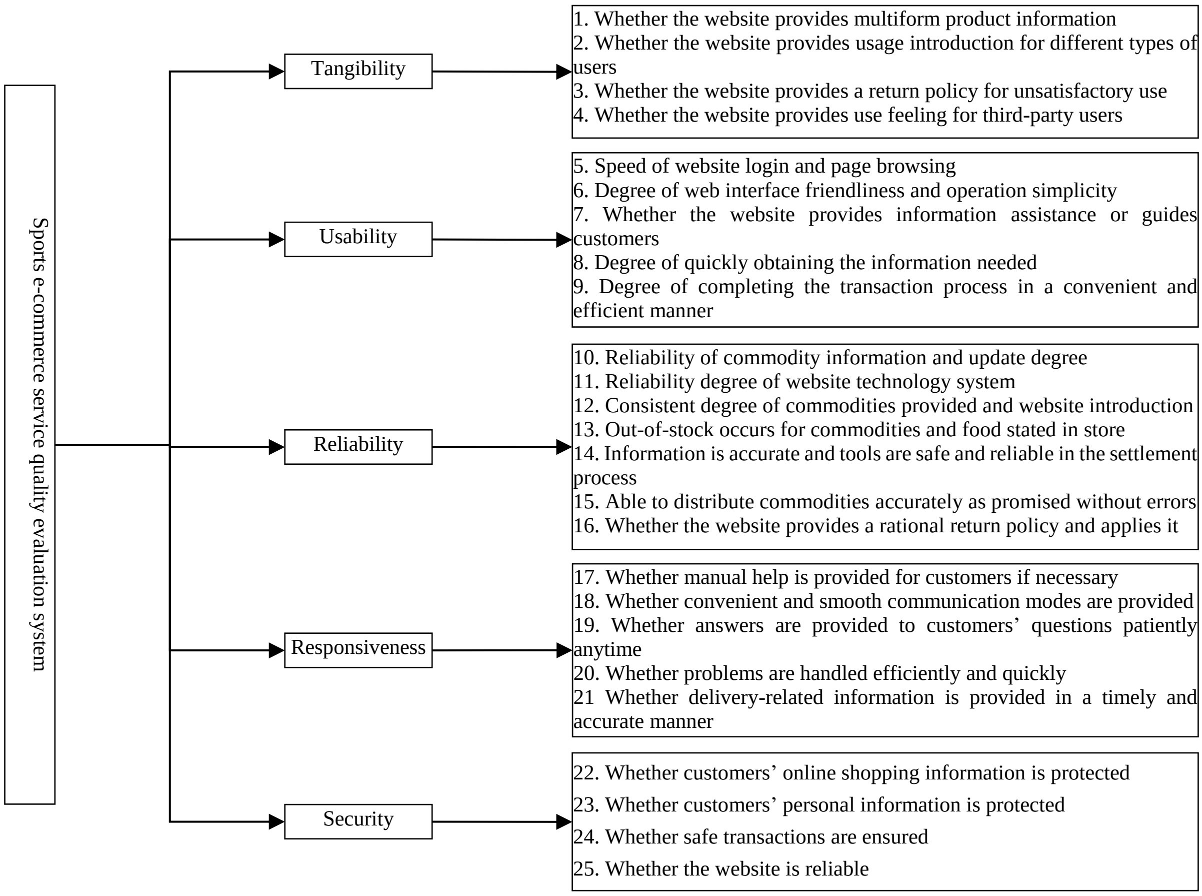

Figure 2. Sports e-commerce service quality evaluation system.

3.2 INDEX FACTOR ANALYSIS

Based on the five original dimensions and the SERVQUAL model with 22 service quality evaluation indexes, five dimensions and 25 e-commerce service quality evaluation indexes were employed in this study in accordance with the features of sports e-commerce service quality, as shown in Fig. 2. A survey was conducted on the survey website and other relevant websites in the form of a questionnaire. After a month of questionnaire distribution through email invitation and a questionnaire webpage link, 179 questionnaires were finally recovered. A total of 138 valid questionnaires were gained.

SPSS statistical software was used to perform factor analysis for the 25 service quality evaluation factors to obtain the weight of each factor. Through 10 times of iteration, five common factors were identified. The factor loading weight after rotation was also obtained (see Table 1).

Table 1 shows that in terms of tangibility, e-commerce merchants should provide more information on commodities and return information to promote e-commerce service quality. In terms of usability, information should be provided to customers, and convenient and efficient transaction policies should be established. With regard to reliability, e-commerce merchants should provide commodity information consistent with the introduction on the website and update this information in a timely manner. As for responsiveness, effective communication modes should be provided, customers' problems should be rapidly solved, and supply-related distribution information should be provided. In terms of security, customers' personal information should be protected, and transaction safety should be ensured.

4 Empirical study

Sports e-commerce service quality evaluation has a multi-factor fuzzy characteristic; thus, FAHP was utilized to evaluate it. FAHP employs a fuzzy matrix based on the original AHP. Thus, FAHP well overcomes the judgment gap of different people and is in accordance with people's ideological logic and mental judgment in decision making. With a simple form, FAHP was utilized to measure the comparative relations among the elements. No possibility of measurement inaccuracy exists in terms of its nature. Although the priority judging matrix is coarse, it can be utilized to establish a fuzzy consistent judgment matrix that meets the consistency condition without the need for a consistency check. Moreover, computational accuracy is satisfied.

TABLE 1 Factor loading matrix

First-class index	Second-class index	Weight
Tangibility U_1	Whether the website provides multiform product information U_{11}	0.749
	Whether the website provides usage introduction for different types of users U_{12}	0.682
	Whether the website provides a return policy for unsatisfactory use U_{13}	0.648

	Whether the website provides use feeling for third-party users U_{14}	0.561
Usability U_2	Speed of website login and page browsing U_{21}	0.604
	Degree of web interface friendliness and operation simplicity U_{22}	0.674
	Whether the website provides information assistance or guides customers U_{23}	0.773
	Degree of quickly obtaining the information needed U_{24}	0.760
	Degree of completing the transaction process in a convenient and efficient manner U_{25}	0.755
Reliability U_3	Reliability of commodity information and update degree U_{31}	0.604
	Reliability degree of website technology system U_{32}	0.680
	Consistent degree of commodities provided and website introduction U_{33}	0.755
	Out-of-stock occurs for commodities and food stated in store U_{34}	0.436
	Information is accurate and tools are safe and reliable in the settlement process U_{35}	0.452
	Able to distribute commodities accurately as promised without errors U_{36}	0.674
	Whether the website provides a rational return policy and applies it U_{37}	0.571
Responsiveness U_4	Whether manual help is provided for customers if necessary U_{41}	0.600
	Whether convenient and smooth communication modes are provided U_{42}	0.718
	Whether customers' questions are answered patiently anytime U_{43}	0.645
	Whether problems are handled efficiently and quickly U_{44}	0.764
	Whether delivery-related information is provided in a timely and accurate manner U_{45}	0.819
Security U_5	Whether customers' online shopping information is protected U_{51}	0.803
	Whether customers' personal information is protected U_{52}	0.834
	Whether safe transactions are ensured U_{53}	0.680
	Whether the website is reliable U_{54}	0.630

4.1 ESTABLISHMENT OF A FUZZY FACTOR SET AND AN EVALUATION SET

According to Table 1, the reference layer of the sports e-commerce service quality evaluation system consists of tangibility, usability, reliability, responsiveness, and security. Each reference layer can be further subdivided as follows:

First-class index set: $U=(U_1, U_2, U_3, U_4, U_5)$

= (tangibility, usability, reliability, responsiveness, security)

Second-class index set:

$$\begin{aligned} U_1 &= (U_{11}, U_{12}, U_{13}, U_{14}) \\ U_2 &= (U_{21}, U_{22}, U_{23}, U_{24}, U_{25}) \\ U_3 &= (U_{31}, U_{32}, U_{33}, U_{34}, U_{35}, U_{36}, U_{37}) \\ U_4 &= (U_{41}, U_{42}, U_{43}, U_{44}, U_{45}) \\ U_5 &= (U_{51}, U_{52}, U_{53}, U_{54}) \end{aligned} \tag{2}$$

We assume that the evaluation set of the evaluation system is V=(very dissatisfied, dissatisfied, general, satisfied, very satisfied) according to the degree of satisfaction, V= (50,60,70,80,90).

4.2 CONFIRMING THE WEIGHT OF THE EVALUATION INDEX

The comparative judgment matrix was established through pairwise comparison of each hierarchical structure. To make the evaluation more accurate, the relatively important scale method proposed by Saaty was employed to determine the relative weights of each factor, as shown in Table 2.

Table 2 Definition of the evaluation index scale

Index scale a_{ij}	Definition
1	Factor i and factor j are equally important
3	Factor i is slightly more important than factor j
5	Factor i is significantly more important than factor j
7	Factor i is strongly more important than factor j
9	Factor i is extremely more important than factor j
2, 4, 6, 8	Scale value of the intermediate state of the above two judgments

As shown in Table 1, factors i and j represent two indexes for comparison under the same factor state or two factors for comparison. The matrix composed of scale a_{ij} is a pairwise comparison matrix. If the relation $a_{ij}=a_{ik}\times a_{kj}$ is met, then the matrix is completely consistent. Its eigenvector corresponding to its largest eigenvalue can relatively express the importance of each index.

Assuming that the weight factor vector corresponding to the evaluation factor set is $\vec{A}$, then

$$\vec{A} = (a_1, a_2, \cdots, a_n), \tag{3}$$

where a_i denotes the role and position of evaluation factor u_i in total evocation factors called the weight. Generally, $a_i \geq 0$ and $\sum a_i = 1$.

Five e-commerce experts were invited to fuzzily grade the relative importance of first-class and second-class indexes via Delphi method. Each expert adopted fuzzy numbers (M1 to M9) to express the relative importance of the indexes. Fuzzy numbers were expressed as (l, m, u), where l is the lowest probable value, m is the most possible value, and u is the highest possible value.

Based on the fuzzy value of grading by experts, the fuzzy matrix of the final index evaluation was obtained as follows:

$$A=\begin{bmatrix} (1,1,1) & (0.26,0.39.0.5) & (1.33,2.67,3.67) & (2,3,4) & (3,2,4) \\ (2,2.67,4) & (1,1,1) & (2.67,3.67,4.67) & (4.67,5.67,6.67) & (6.67,7.67,8.67) \\ (0.21,0.33,0.5) & (0.23,0.61,1.58) & (1,1,1) & (4,5,6) & (5,4,7) \\ (0.21,0.33,0.5) & (0.15,0.2,0.25) & (0.18,0.2,0.25) & (1,1,1) & (0.23,034,0.2) \\ (0.21,0.33,0.5) & (0.2,0.31,0.13) & (0.19,0.2,0.24) & (0.23,0.2,0.4) & (1,1,1) \end{bmatrix}$$

Equation (2) is as follows:

$$D=\sum_{j=1}^{n} a^{k}{}_{ij} \div \left(\sum_{i=1}^{n}\sum_{j=1}^{n} a^{k}{}_{ij}\right), i=1,2\cdots,n \quad (4)$$

where a_{ij} represents the comparative fuzzy number of factors i and j. The comprehensive fuzzy value (i.e., initial weight) of the k^{th} layer of factors can be determined according to Equation (2).

Through calculation, the initial weights of U_1, U_2, U_3, U_4, and U_5 are

$$D^1_{U_1}=\sum_{i=1}^{4} a^1{}_{ij} \div \sum_{i=1}^{4}\sum_{j=1}^{4} a^1{}_{ij} = (0.125,\ 0.246,\ 0.419)$$

$$D^1_{U2}=(0.28,\ 0.45,\ 0.75)$$

$$D^1_{U3}=(0.15,\ 0.24,\ 0.41)$$

$$D^1_{U4}=(0.04,\ 0.66,\ 0.09)$$

$$D^1_{U5}=(0.02,\ 0.39,\ 0.04)$$

Defuzzification was then conducted for each index. M1 (l1, m1, u1) and M2 (l2, m2, u2) belong to a triangular fuzzy number. When M1 ≥ M2, a triangular fuzzy function is defined as follows:

$$v(M1\geq M2)=\sup_{x\geq y}\left[\min(uM1(x),uM2(y))\right] \quad (5)$$

$$v(M1\geq M2)=\mu(d)=\begin{cases} 1, & m1\geq m2 \\ \dfrac{l2-u1}{(m1-u1)-(m2-u2)}, & m1\leq m2, u1\geq l2 \\ 0 & otherwise \end{cases} \quad (6)$$

Defuzzification reveals the possibility of a fuzzy number and other any k fuzzy numbers. Then,

V（M≥M1,M2,⋯, Mk）=minV(M≥Mi) , i=1,2,⋯, k.

Fuzzification was also conducted for D^1_{U1}, D^1_{U2}, D^1_{U3}, D^1_{U4}, and D^1_{U5}. The rough prices are as follows:

$$V(D^1_{U_1}\succ D^1_{U2})=1,$$

$$V(D^1_{U_1}\succ D^1_{U3})=\frac{5.44-9.17}{(7.06-9.17)-(6.94-5.44)}=3.61,$$

$$V(D^1_{U_1}\succ D^1_{U4})=\frac{0.04-9.17}{(7.06-9.17)-(0.06-0.04)}=4.27$$

$$V(D^1_{U_1}\succ D^1_{U5})=2.87.$$

$$d(U_1)=\min V(D^1_{U_1}\succ D^1_{U2},D^1_{U3},D^1_{U4},D^1_{U5})=1,$$

$$d(U_2)=\min V(D^1_{U2}\succ D^1_{U1},D^1_{U3},D^1_{U4},D^1_{U5})=1,$$

$$d(U_3)=\min V(D^1_{U_3}\succ D^1_{U1},D^1_{U2},D^1_{U4},D^1_{U5})=0.97,$$

$$d(U_4)=\min V(D^1_{U4}\succ D^1_{U1},D^1_{U2},D^1_{U3},D^1_{U5})=1,$$

$$d(U_5)=\min V(D^1_{U5}\succ D^1_{U1},D^1_{U2},D^1_{U3},D^1_{U4})=1.$$

Through standardization of the above primary weights, the final weight of the first-class indexes is

$$W=(W_{U1},W_{U2},W_{U3},W_{U4},W_{U5}) =(0.201,0.201,0.195,0.201,0.201)$$

In accordance with the above calculation process, the weights of the indexes in each level can be further solved. The obtained results are shown in Table 4.

TABLE 4 Weight vector of the index level relative to the target layer as well as other weight vectors

Weight of the first-class index layer	Weight of the second-class index layer	
	Weight relative to first-class index layer	Weight relative to target layer
W_1 0.201	W_{11} 0.0753	0.0189
	W_{12} 0.0936	0.0189
	W_{13} 0.0888	0.0224
	W_{14} 0.0769	0.0194
W_2 0.201	W_{21} 0.0828	0.0209
	W_{22} 0.1060	0.0267
	W_{23} 0.1043	0.0263
	W_{24} 0.1036	0.0261
	W_{25} 0.0829	0.0209
W_3 0.195	W_{31} 0.1795	0.0452
	W_{32} 0.1037	0.0261
	W_{33} 0.1075	0.0271
	W_{34} 0.1602	0.0404
	W_{35} 0.1358	0.0342
	W_{36} 0.1427	0.0360
	W_{37} 0.1706	0.0430
W_4 0.201	W_{41} 0.2895	0.0706
	W_{42} 0.3429	0.0837
	W_{43} 0.3676	0.0897
	W_{44} 0.2453	0.0789
	W_{45} 0.3503	0.0890
W_5 0.201	W_{51} 0.2745	0.0692
	W_{52} 0.2830	0.0713
	W_{53} 0.2307	0.0581
	W_{54} 0.2138	0.0639

4.3 ANALYSIS OF THE EVALUATION RESULTS

The probability of each evaluation index of sports e-commerce service quality at different ratings is determined based on the questionnaire information. In other words, judgment coefficient matrix C_I of the evaluation indexes was obtained. According to fuzzy comprehensive evaluation formula $B_i=C_I*W_i$, the fuzzy comprehensive evaluation set of the first-class evaluation indexes of service quality is as follows:

$B_1 = (0.0169, 0.0796, 0.4171, 0.2865, 0.2016)^T$;

$B_2 = (0.0093, 0.0389, 0.3291, 0.4021, 0.2101)^T$;

$B_3 = (0.0082, 0.0446, 0.4414, 0.3099, 0.1960)^T$;

$B_4 = (0.0333, 0.0914, 0.3662, 0.2863, 0.2248)^T$;

$B_5 = (0.0209, 0.0780, 0.2172, 0.3570, 0.2601)^T$.

$$B = \begin{bmatrix} 0.0169 & 0.0093 & 0.0082 & 0.0333 & 0.0209 \\ 0.0796 & 0.0389 & 0.0446 & 0.0914 & 0.0780 \\ 0.4171 & 0.3291 & 0.4414 & 0.3662 & 0.2172 \\ 0.2865 & 0.4021 & 0.3099 & 0.2863 & 0.3570 \\ 0.2016 & 0.2101 & 0.1960 & 0.2248 & 0.2601 \end{bmatrix}.$$

Thus, the fuzzy evaluation matrix of sports e-commerce service quality under the current environment can is

$$P = B \times W = (0.017, 0.0638, 0.388, 0.3213, 0.2082)^T$$

In lieu with the conversion and quantitative criteria, the final evaluation score of sports e-commerce service quality is 78.23. Similarly, the expected evaluation score of sports e-commerce customers for e-commerce merchants is 87.39. As indicated by these research results, customers require all-sided commodity information from e-commerce, updating and guaranteeing consistency between commodities and website information, and ensuring information security. Fuzzy evaluation shows that the service quality score under the current e-commerce environment is low, and a large gap exists with e-commerce service quality expected by customers. This finding indicates that e-commerce service quality still require improvement.

5 Conclusions

The SERVQUAL model and FAHP were combined to evaluate e-commerce service quality. The principle is relatively simple. Although data analysis and calculation processes are complex, efficiency and accuracy are improved significantly by applying programming software with computer development. The developed fuzzy comprehensive evaluation system for sports e-commerce service quality based on the SERVQUAL model can well perform fuzzy quantization of factors that cannot be quantified in human factor evaluation. In the evaluation process, the system can consider the influences of each index and is thus in accordance with actual situations of e-commerce. The analysis and evaluation conducted in this study provide a reference value for further investigation of service quality evaluation.

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