



International Journal of Web Based Communities

ISSN online: 1741-8216 - ISSN print: 1477-8394
<https://www.inderscience.com/ijwbc>

Research on the fuzzy comprehensive evaluation of consumer satisfaction with mobile e-commerce platforms

Xulan He

DOI: [10.1504/IJWBC.2023.10048317](https://doi.org/10.1504/IJWBC.2023.10048317)

Article History:

Received:	22 June 2021
Accepted:	25 November 2021
Published online:	20 January 2023

Research on the fuzzy comprehensive evaluation of consumer satisfaction with mobile e-commerce platforms

Xulan He

Business Starting School,
Yiwu Industrial and Commercial College,
Yiwu 322000, China
Email: xulan@mls.sinanet.com

Abstract: The traditional method has the problems of a short evaluation time, accurate information retrieval and accurate evaluation, therefore, a new fuzzy comprehensive evaluation method for consumer satisfaction with mobile e-commerce platforms is proposed. First, the relevant content of mobile e-commerce platforms is analysed based on the content and functional characteristics of the design rules of fuzzy evaluation. Then, customer satisfaction evaluation principles are analysed, and the corresponding secondary evaluation index is established based on the weight of each index to complete a specific consumer satisfaction fuzzy comprehensive evaluation. The experimental results show that the time of the evaluation result generation process of this method is between 27 s and 33 s, the retrieval accuracy of consumer-related information is between 0.931 and 0.952, and the evaluation accuracy is between 93.0% and 95.6%. The above results effectively prove the effectiveness of this method.

Keywords: mobile e-commerce platform; consumer satisfaction; fuzzy rules; satisfaction evaluation; index weight.

Reference to this paper should be made as follows: He, X. (2023) 'Research on the fuzzy comprehensive evaluation of consumer satisfaction with mobile e-commerce platforms', *Int. J. Web Based Communities*, Vol. 19, No. 1, pp.28–38.

Biographical notes: Xulan He received her Bachelor's in Business Administration from JiangXi University of Finance and Economics in 2015. Currently, she is a Lecturer in the Business Starting School of Yiwu Industrial and Commercial College. Her research interests include e-commerce, innovation and entrepreneurship.

1 Introduction

Thus far, the product circulation industry has developed rapidly, and the volume of transactions involving various products has been increasing year by year, promoting the further development of e-commerce platforms. From the intrusion and development of the new generation of the internet to the entry of large brands and enterprises, various development modes of mobile e-commerce platforms continue to appear. The high-frequency rigid demand for mobile e-commerce platforms has great room for

improvement (Xiao and Zhu, 2018; Yuan et al., 2019). With economic and social development, China's consumer groups are becoming younger, and their consumption habits are also changing. Consumers are more willing to improve their personal consumption level, and their requirements for mobile e-commerce platform services are increasing (Yin and Xie, 2020).

Wang (2020) designs an e-commerce consumer satisfaction evaluation method based on deep learning. This method considers that the consumer's comment information includes the degree of satisfaction with goods, logistics and other e-commerce services. Therefore, it designs a satisfaction evaluation method based on the vision of opinion mining and combined with the deep learning process. However, in practical application, it is found that this method has the disadvantage of a long evaluation process. Li et al. (2019) design an e-commerce customer satisfaction evaluation method based on preferences and unbalanced semantic evaluation. This method divides the satisfaction evaluation process into two parts: the quantitative processing of e-commerce customer evaluation language and information processing and analysis. At the same time, aiming to address the problems of poor performance and a skewed distribution in the quantitative processing of customer evaluation language, an unbalanced evaluation scale is determined. Then, the attitude of e-commerce customers is expressed based on preference semantics. On this basis, the evaluation results are quantified and analysed by binary uncertainty semantics, which reflect fuzziness and overcome integration bias. Gao and Jia (2019) design a cross-border e-commerce consumer satisfaction evaluation method based on ECSI, and it uses the consumer satisfaction index model to screen the e-commerce consumer satisfaction indicators and establishes the relevant index system. On this basis, this paper analyses the impact path of e-commerce consumer satisfaction and then constructs specific evaluation methods based on the analysis results. However, the above two methods have the disadvantages of low information retrieval accuracy and evaluation accuracy.

In view of the problems existing in the above methods, this paper proposes a new fuzzy comprehensive evaluation method for consumer satisfaction with mobile e-commerce platforms.

First, the content of mobile e-commerce platforms is divided into six parts: the main page, commodity page, payment interface, dialog box, after-sales page and personal centre. Based on the content and functional characteristics of each part, fuzzy evaluation rules are designed.

Second, the method analyses the evaluation principle of consumer satisfaction and sets up 4 first-level evaluation indices and 11 second-level evaluation indices to complete the specific fuzzy comprehensive evaluation of consumer satisfaction based on the weight of each index.

Finally, the time-consuming process of evaluation result generation, the retrieval accuracy of consumer-related information and the evaluation accuracy of different methods are compared through experiments.

2 Correlation analysis of mobile e-commerce platforms

A mobile e-commerce platform is the main medium for consumers to browse, select, place orders, consult and apply for after-sale services in the online shopping process (Huang et al., 2021; Xu, 2019). From the perspective of content and functions, a mobile

e-commerce platform is mainly composed of six parts: the home page, commodity page, payment interface, dialog box, after-sales page and personal centre. The content of pages is mainly reflected by commodity pictures, videos, texts, payment links, dialog boxes and other elements, and consumers need to obtain this information through different pages (Ma and Li, 2020; Wang, 2019). Therefore, mobile e-commerce platforms can play a good bridging role between consumers and different businesses.

The following is a detailed analysis of each functional module of mobile e-commerce platforms.

- 1 Personal centre. On the personal centre page, the user's nickname, user level, status and other information are displayed, and the information content changes based on changes in the consumer's own status.
- 2 Main page and product page. On the home page and the product page, the content information of mobile e-commerce platforms, such as product information, store information, promotions or new information, is displayed. Generally, it is in the more prominent area of the interface, making it convenient for consumers to quickly find and saving interface space to a certain extent.
- 3 Dialog box and after-sales page. In the dialog box and after-sales page, consumers can communicate with merchants or the customer service personnel of the platform to complete shopping consultations, transaction communication, after-sales rights protection and other operations (Zhang, 2020; Wen and Zhang, 2020).
- 4 Payment interface. A secure payment link is set in the payment interface. After selecting the payment option, the consumer clicks the online banking payment gateway button and then follows the prompts on the page to generate the online payment code, which can be pasted into the appropriate position to complete the online payment. After the payment contract is signed, the online payment service takes effect.

Only through continuous reform and innovation can we more effectively improve the turnover of a platform to meet the comprehensive needs of consumers from more perspectives. To further enhance the practicability and reliability of mobile e-commerce platforms, consumers' satisfaction with platforms should be evaluated, and platforms should be continuously optimised and improved based on the evaluation results (Lei et al., 2020; Chen, 2019; Fan, 2017). Next, this study carries out an effective evaluation of consumer satisfaction with mobile e-commerce platforms through fuzzy rule design.

3 Evaluation method design

3.1 Fuzzy rule design

Suppose the accident fuzzy rule is as follows: if J and L , then K . Therefore, this study combines the existing data and expert discussion results to identify fuzzy rules to summarise the final comprehensive fuzzy control rules.

Assuming that there are N rules altogether, the two exogenous variables input into the rule are defined as J' and L' (fuzzy comprehensive evaluation index coefficient of

customer satisfaction). Then, the comprehensive fuzzy rule K' is obtained based on the following process.

For any fuzzy inference rule, the characteristic coefficients f and g of two exogenous variables are first calculated. The process is as follows:

$$\begin{cases} f = \sup J' \times V \\ g = \sup L' \times V \end{cases} \quad (1)$$

where V represents the membership function of exogenous variables. Thus, the fuzzy evaluation rules can be obtained as follows:

$$K' = \forall (f \wedge g \wedge N) \quad (2)$$

The result obtained by fuzzy reasoning is a fuzzy set, which can also be said to be a fuzzy quantity. However, the evaluation results of consumer satisfaction with an actual mobile e-commerce platform must be accurate, and a certain value can be applied to practice. Therefore, the fuzzy evaluation rules must be defuzzified. In the fuzzy quantity obtained by fuzzy reasoning, the process of finding a single value that can best represent the fuzzy set is called defuzzification. The most commonly used method is the centre of gravity method. It takes the centre of gravity of the area enclosed by the membership function curve of the reasoning conclusion fuzzy set and the abscissa as the representative point; that is,

$$y' = \frac{\int y \mu_{C_j}(y) dy}{\int \mu_{C_j}(y) dy} \quad (3)$$

In the above formula, y represents the output variable, C_j represents fuzzy language, and μ represents the fuzzy centre of gravity.

When the membership function of the output variable is a discrete single point set, it is:

$$y' = \frac{\sum_1^n \mu_{C_j}(y_j) y_j}{\sum_1^n \mu_{C_j}(y_j)} \quad (4)$$

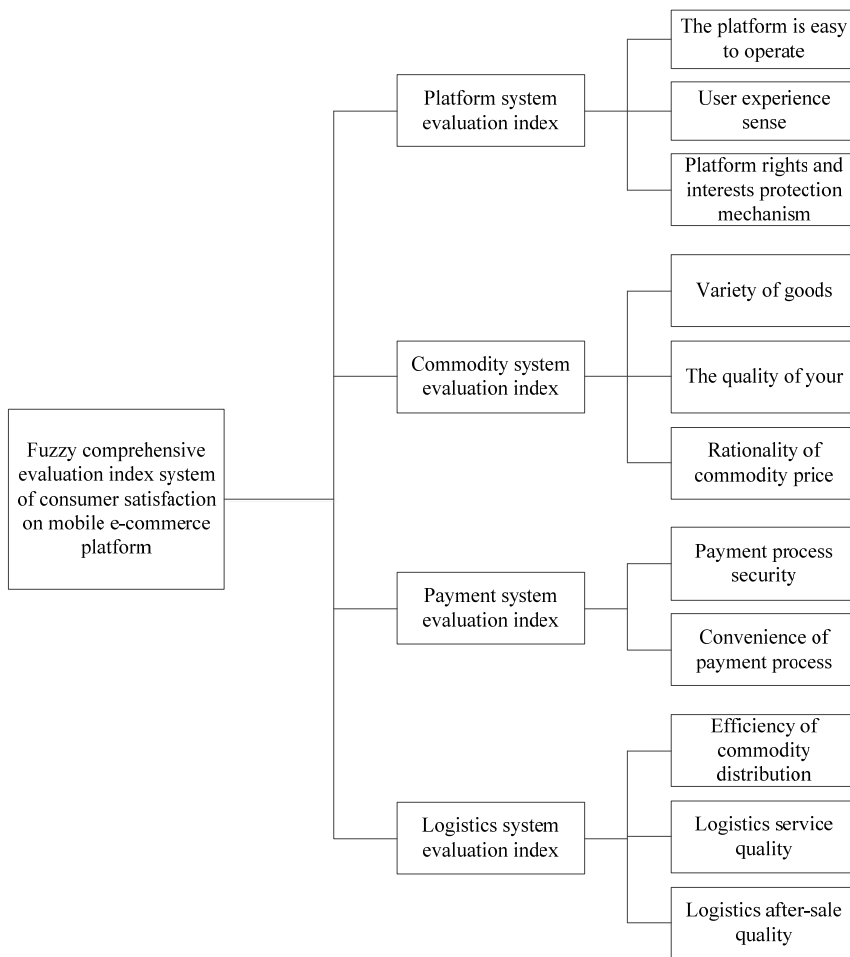
In the above formula, y_j represents the optimal output variable.

The fuzzy evaluation rules are optimised by using the defuzzification parameters. The optimisation results are obtained as follows:

$$K'' = \frac{\forall (f \wedge g \wedge N)}{y'} \quad (5)$$

The fuzzy rules obtained through the above process can be considered a fuzzy set of endogenous variables (Zhang et al., 2019). In summary, the analysis and discussion of fuzzy evaluation rules are completed, and they can be used in consumer satisfaction evaluation, combined with more mobile e-commerce platform consumer satisfaction evaluation indicators and their weight values, to obtain a better evaluation effect.

Figure 1 Fuzzy comprehensive evaluation index system for consumer satisfaction with mobile e-commerce platforms



3.2 Principle and index setting of the evaluation of consumer satisfaction with mobile e-commerce platforms

The purpose of constructing the fuzzy comprehensive evaluation method for consumer satisfaction with mobile e-commerce platforms in this study is to evaluate the development and application of e-commerce platforms more scientifically and reasonably to measure the advantages and disadvantages of the development of e-commerce platforms, analyse their internal reasons and help them achieve better development. Therefore, the following consumer satisfaction evaluation principles are set to ensure the integrity of all influencing factors of the evaluation indicators:

- 1 Systematicity. Under this principle, the evaluation process should be considered systematically in the selection of evaluation indicators to obtain more comprehensive

evaluation results. In the evaluation process, to prevent evaluation process redundancy, each index should be independent of each other.

- 2 Practical significance. Under the principle of practical significance, in the selection of evaluation indicators, the indicators selected can truly and scientifically reflect the development status of an e-commerce platform, and the indicators can give a relatively objective evaluation of the e-commerce platform regardless of whether they are good or bad.

Based on the above index setting principles, the evaluation indices are set as follows:

- a The platform system evaluation indicators include platform operation convenience, the sense of user experience, and a platform rights and interests protection mechanism.
- b The commodity system evaluation indicators include commodity variety, commodity quality and commodity price rationality.
- c The payment system evaluation indicators include payment process security and payment process convenience.
- d The logistics system evaluation indicators include commodity distribution efficiency, logistics service quality, and logistics after-sales quality.

In summary, this study designs four first-level indicators and 11 second-level indicators to construct an index system, as shown in Figure 1.

3.3 Design of a fuzzy comprehensive evaluation process for consumer satisfaction with mobile e-commerce platforms

- 1 Platform system evaluation index I_1 . This index is the main index for measuring the basic functions of mobile e-commerce platforms. It is mainly reflected by platform operation convenience p_1 , user experience p_2 and the platform rights and interests guarantee mechanism p_3 . The calculation process is as follows:

$$I_1 = \alpha p_1 + \beta p_2 + \gamma p_3 \tag{6}$$

- 2 Commodity system evaluation index I_2 . This index analyses and evaluates consumers' satisfaction with goods on mobile e-commerce platforms from three perspectives: commodity variety c_1 , commodity quality c_2 and commodity price rationality c_3 . The calculation process is as follows:

$$I_2 = \rho c_1 + \sigma c_2 + \tau c_3 \tag{7}$$

- 3 Payment system evaluation index I_3 . This index analyses and evaluates consumers' satisfaction with the payment procedures on mobile e-commerce platforms from two perspectives: payment process security a_1 and payment process convenience a_2 . The calculation process is as follows:

$$I_3 = \varepsilon a_1 + \delta \tag{8}$$

- 4 Logistics system evaluation index I_4 . This index evaluates consumers' satisfaction with the logistics service of mobile e-commerce platforms from the perspectives of commodity distribution efficiency d_1 , logistics service quality d_2 and logistics after-sales quality d_3 . The calculation process is as follows:

$$I_4 = Jd_1 + \varphi d_2 + \omega_3 \quad (9)$$

To reduce the influence of human factors on the weight calculation results, it is necessary to use fuzzy rules to defuzzify the expert evaluation results x_{ij} to obtain the weight of the fuzzy comprehensive evaluation index of consumer satisfaction with mobile e-commerce platforms. The specific calculation formula is as follows:

$$y_{ij} = \frac{x_{ij} + x'_{ij}}{\sum_{i=1}^m x'_{ij}} \quad (10)$$

In the above formula, m represents the number of evaluation indices and x'_{ij} represents the j^{th} index of the i^{th} evaluation object.

In summary, under the control of fuzzy control rules and combined with the four first-level indicators designed, the final fuzzy comprehensive evaluation results of consumer satisfaction with mobile e-commerce platforms are obtained as follows:

$$G = \sum_{i=1}^4 I_i \times K'' \times y_{ij} \quad (11)$$

4 Experimental verification and result analysis

4.1 Experimental scheme design

To test the feasibility and practicability of the fuzzy comprehensive evaluation method for consumer satisfaction with mobile e-commerce platforms designed above, the following simulation experiments are designed and analysed.

The experimental environment is set as follows: the experimental host processor is I9-9900xe, which takes the Windows 10 system as the background operating system and uses MATLAB software to build the simulation environment to effectively evaluate consumer satisfaction with e-commerce platforms.

The data used in the experiment are from the MySQL e-commerce database. The relevant consumer data on mobile e-commerce platforms are obtained from the database, and the collected data are cleaned and optimised to improve the accuracy of the simulation experiment. Based on the data obtained,

The experimental index design process is as follows:

- 1 Evaluation process time: This index can reflect the efficiency of different evaluation methods. The lower the amount of time that is spent in the evaluation process, the higher the efficiency of the evaluation method, and the faster the output of the evaluation results in a shorter amount of time. In contrast, the higher the amount of time that is spent in the evaluation process, the lower the efficiency of the evaluation method.

- 2 Accuracy of consumer-related information retrieval. This index can reflect the reliability of different methods. The value range of retrieval accuracy is [0,1]. The closer the retrieval accuracy is to 1, the higher the reliability of the evaluation method. The retrieval accuracy of consumer-related information is determined by the adaptability of evaluation indices and the recall rate of consumer satisfaction information.

$$Q = \frac{2ab}{a + b} \tag{12}$$

In equation (8), Q represents the retrieval accuracy of consumer-related information, a represents the recall rate of consumer satisfaction information, and b represents the self-fitness of the evaluation index.

- 3 Evaluation accuracy: This index can directly reflect the effectiveness of different evaluation methods. The higher the evaluation accuracy is, the higher the effectiveness of the evaluation method, and the more helpful it is in accurately analysing consumer satisfaction with mobile e-commerce platforms. In contrast, the lower the evaluation accuracy is, the lower the effectiveness of the evaluation method.

Using the experimental environment and indicators designed above, the application performance of the method of this paper, the Wang (2020) method and the Li et al. (2019) method is compared and verified. To ensure the validity and reliability of the results obtained and to avoid the influence of environmental factors and errors on the experimental results as much as possible, the experiment is repeated several times. To ensure the uniqueness of the experimental environment, the number of experiments is uniformly set to 50.

4.2 Results and analysis

4.2.1 Time spent in the evaluation process

First, when the evaluation process of different consumer satisfaction evaluation methods is counted, the results are shown in Table 1.

Table 1 Statistical results of different evaluation methods during the evaluation process (s)

<i>Number of experiments/time</i>	<i>Wang (2020) method</i>	<i>Li et al. (2019) method</i>	<i>Method in this paper</i>
10	83	71	28
20	85	72	30
30	94	75	29
40	92	69	33
50	94	73	27

By comparing the results in Table 1, it can be seen that the evaluation result generation process time of the Wang (2020) method varies between 83 s and 94 s. The evaluation result generation process time of the Li et al. (2019) method varies between 69 s and 75 s. However, the time of the evaluation result generation process of the method in this paper

varies between 27 s and 33 s. Thus, the evaluation process of this method takes less time, which indicates that this method has high work efficiency and can quickly output the evaluation result of consumer satisfaction with mobile e-commerce platforms in a short amount of time.

4.2.2 Accuracy of consumer-related information retrieval

Equation (8) is used to calculate the retrieval accuracy of consumer-related information of different evaluation methods, and the comparison results are shown in Table 2.

Table 2 Comparison of the consumer-related information retrieval accuracy of different methods

<i>Number of experiments/time</i>	<i>Wang (2020) method</i>	<i>Li et al. (2019) method</i>	<i>Method of this paper</i>
10	0.821	0.844	0.931
20	0.837	0.848	0.933
30	0.837	0.851	0.946
40	0.842	0.895	0.941
50	0.868	0.908	0.952

By analysing the experimental results shown in Table 2, it can be seen that the retrieval accuracy of consumer-related information of the Wang (2020) method is between 0.821 and 0.868 and that of the Li et al. (2019) method is between 0.844 and 0.908. However, the retrieval accuracy of consumer-related information of the method of this paper is between 0.931 and 0.952. Compared with the two traditional evaluation methods, the retrieval accuracy of consumer-related information of the method of this paper is closer to 1. Therefore, the fuzzy comprehensive evaluation method for consumer satisfaction with mobile e-commerce platforms designed in this paper is more reliable.

4.2.3 Evaluation of accuracy

In the verification in this section, evaluation accuracy is taken as the index to carry out comparative tests on the effectiveness of different methods, and the results are shown in Table 3.

Table 3 Comparison of the evaluation accuracy of different evaluation methods (%)

<i>Number of experiments/time</i>	<i>Wang (2020) method</i>	<i>Li et al. (2019) method</i>	<i>Method of this paper</i>
10	83.2	85.6	93.0
20	83.4	84.7	95.6
30	86.1	87.1	93.1
40	87.4	89.8	94.9
50	87.6	84.8	92.8

By comparing the results in Table 3, it can be seen that after the application of the Wang (2020) method, with the increase in the number of experiments, its evaluation accuracy varies between 83.2% and 87.6%. After the application of the Li et al. (2019) method, its

evaluation accuracy varies between 84.7% and 89.8% with the increase in the number of experiments. However, with the application of the method in this paper, the evaluation accuracy varies between 93.0% and 95.6% with the increase in the number of experiments.

In summary, by comparing the results of the three groups of experiments, it can be seen that the evaluation result generation process of the fuzzy comprehensive evaluation method for consumer satisfaction with mobile e-commerce platforms designed in this study changes between 27 s and 33 s, the retrieval accuracy of consumer-related information varies between 0.931 and 0.952, and the evaluation accuracy varies between 93.0% and 95.6%. Thus, the method in this paper is proven to be more efficient and reliable and has more application advantages.

5 Conclusions

- 1 To effectively solve the problems existing in traditional evaluation methods, such as the long duration of the evaluation process, low information retrieval accuracy and low evaluation accuracy, this paper proposes a new fuzzy comprehensive evaluation method for consumer satisfaction with mobile e-commerce platforms.
- 2 According to the comparative experimental results, the time of the evaluation result generation process of the method in this paper varies between 27 s and 33 s, which proves that the method has higher working efficiency and can output the evaluation result quickly in a shorter amount of time. The retrieval accuracy of this method is between 0.931 and 0.952, which proves that its reliability is higher. The evaluation accuracy of the method in this paper varies between 93.0% and 95.6%, which proves that it is more effective and can help accurately analyse consumer satisfaction with mobile e-commerce platforms.
- 3 Although this method has achieved a good application effect, its application effect in terms of individual evaluation is inferior to that of comprehensive evaluation. Therefore, in future research, the single-item evaluation ability of the evaluation method will be further improved.

References

- Chen, K. (2019) 'Research on influencing factors of satisfaction with fresh agricultural products purchasing on consumer e-commerce platform', *China Collective Economy*, Vol. 23, No. 18, pp.68–69.
- Fan, J. (2017) 'Satisfaction evaluation of online shopping consumers based on fuzzy comprehensive evaluation method', *Marketing Research*, Vol. 22, No. 6, pp.31–32.
- Gao, X. and Jia, L. (2019) 'An empirical study on consumer satisfaction of cross-border e-commerce based on ECSI', *Shandong Social Sciences*, Vol. 15, No. 5, pp.149–154.
- Huang, M., Lv, Q. and Lin, B. (2021) 'The influencing factors of the consumer satisfaction of B2C fresh food e-commerce', *Journal of Fujian Agriculture and Forestry University (Philosophy and Social Sciences)*, Vol. 24, No. 1, pp.32–40.

- Lei, B., Liu, X. and Zhong, Z. (2020) 'The influence of transaction attribute on consumer satisfaction in online shopping of fresh agricultural products: based on fruit category online review mining analysis', *Enterprise Science And Technology and Development*, Vol. 26, No. 12, pp.136–139.
- Li, Y., Zou, F. and Xie, W. (2019) 'Customer satisfaction measurement combining with preference and unbalanced linguistic evaluation', *Computer Integrated Manufacturing Systems*, Vol. 25, No. 1, pp.165–172.
- Ma, F. and Li, C. (2020) 'Research on E-commerce consumer satisfaction measurement of fresh products—analysis based on online reviews of JD fresh', *Price*, Vol. 25, No. 5, pp.117–120, Theory & Practice.
- Wang, H. (2020) 'An e-commerce satisfaction evaluation method based on deep learning', *Chinese Journal of Electron Devices*, Vol. 43, No. 1, pp.196–199.
- Wang, X. (2019) 'Service quality evaluation model of express enterprises based on customer satisfaction', *System Simulation Technology*, Vol. 15, No. 1, pp.47–51.
- Wen, C. and Zhang, X. (2020) 'Research on fresh e-commerce logistics evaluation system based on consumer satisfaction', *Journal of Shanxi Coal-Mining Administrators College*, Vol. 33, No. 2, pp.75–77.
- Xiao, H. and Zhu, X. (2018) 'Research and empirical analysis of user satisfaction in mobile e-commerce vision', *Mathematics in Practice and Theory*, Vol. 48, No. 7, pp.147–155.
- Xu, G. (2019) 'Research on the evaluation of fresh e-commerce's logistics service quality based on rough set', *China Business and Market*, Vol. 33, No. 7, pp.35–44.
- Yin, X. and Xie, T. (2020) 'Research on the transformation path from consumer satisfaction to consumer loyalty of cross-border import e-commerce platform', *Commercial Times*, Vol. 15, No. 1, pp.90–93.
- Yuan, Z., Zhu, J., Wang, T. and Che, Z. (2019) 'Research on comprehensive evaluation and operation countermeasures of consumer satisfaction on 'double 11'', *Normal Science Journal*, Vol. 39, No. 8, pp.17–21.
- Zhang, J., Liang, H. and Du, H. (2019) 'Research on service-satisfaction evaluation of e-commerce maker space from the perspective of ecosystem view', *Technoeconomics and Management Research*, Vol. 41, No. 11, pp.49–52.
- Zhang, K. (2020) 'Research on fuzzy comprehensive evaluation of consumer satisfaction of fresh e-commerce platform based on AHP', *China Management Informationization*, Vol. 23, No. 20, pp.153–156.