Improvement of Adjustment Coefficient of User Demand Importance Based on Competitiveness Analysis

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Abstract. In order to study the influencing factors of customer satisfaction, a demand importance research method combining KANO model and competitiveness analysis is proposed. The classified user demand categories were visualized in word cloud, the top N maximum probability terms under each topic were selected as product features, and the attribute-element-comment tripartite mapping was completed based on clustering. The fuzzy KANO model was introduced to set up questionnaires, and the obtained various demand elements were divided into fine-grained categories. Finally, the importance of competitive products is introduced as an improvement coefficient to carry out competitiveness analysis to find out the importance of different needs to improve user satisfaction. The priority order of demand importance under user reviews is refined, and the differentiation of demand importance difference is significant, so as to further guide enterprises to obtain maximum user satisfaction with minimum investment. The validity of this method is proved by the test of customer satisfaction of Xiaomi mobile phone.

Keywords—user needs; fuzzy KANO model; customer satisfaction rate；topic model

1. INTRODUCTION

With the development of the Internet and the popularity of online shopping, consumers' shopping channels and methods have undergone fundamental changes. The convenience and flexibility of Internet shopping make it more convenient for consumers to buy the products and services they need, but the uneven quality of product supply and service makes consumers blind and random when making purchase decisions [1]. At the same time, for enterprises, the flexibility and convenience of Internet shopping make it more convenient for consumers to buy the products and services they need, and also intensify the competition among enterprises. In such competition, higher requirements and expectations are put forward for the products and services produced by enterprises [2].Zhang[3] used the four-quadrant model to establish the functional relationship between customer satisfaction and product satisfaction and quality, and adjusted the correlation coefficient to obtain the importance of user demand. Ummi[4]. proposed that customer satisfaction is the level at which the perceived performance of a product matches customer expectations. Based on this, they studied the importance Performance Analysis (IPA) method and the integration of KANO model to understand the service attributes that need to be improved. Stella B[5] suggests a practical canoe model approach and expectation confirmation

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theory for related organizations and practitioners to correctly identify customer needs and channel resources in the right direction. Shi Y[6] believes that the classification of customer needs has an important impact on the solution of product design. Customer reviews defined based on the emotion level of adjectives and adverbs use word vectors, and make use of big data of online customer reviews of products to accurately and effectively classify reviews. Matzler K[7] examined the limited empirical evidence on the temporal variation of the nonlinear relationship between attribute performance and customer satisfaction, and applied nonlinear structural equation modeling to summarize the trend of satisfaction over time. Li He[8] .combined the LDA topic model with the KANO model, extracted keywords under the topic and set weights, divided four types of user needs into fine-grained categories, and verified the reliability of the classification through relevant experiments. Cao Yang[9].used the topic model to cluster user reviews, established a demand element system, set up a demand questionnaire combined with the user satisfaction index, and finally determined the importance and priority order of different demands. Based on the KANO model, Wang Xue[10] created an analysis framework for user comment requirements. Based on BERT model, user comment needs under different attributes are marked, and sentiment analysis results are carried out according to user comments on different attributes and KANO model is used to obtain user attribute needs. Zhao Yuqing[11] combined the fuzzy Kano model with sentiment analysis to build a demand-satisfaction quantitative model, realized the quantitative evaluation of user satisfaction, and classified the obtained user comments.

2. Solve the importance of user needs

2.1 Calculation of adjustment factor K

In the KANO model [12], the quantitative relationship between user satisfaction and product function can be expressed by a function with parameters, the expression is S=f(K,p). Where p is the value of users' satisfaction with products or services, and K is the undetermined coefficient of product demand type in KANO model [13]. Because of the presence of K value, different demand types of product functions or services have different impacts on user satisfaction.

Basic Quality: $$\frac{\Delta s}{\Delta s} \prec \frac{\Delta p}{p} \tag{1}$$

Performance Quality: $$\frac{\Delta s}{\Delta s} = \frac{\Delta p}{p} \tag{2}$$

Attractive Quality: $$\frac{\Delta s}{\Delta s} = k(\frac{\Delta p}{p}) \tag{3}$$

Express the above user requirements in an identity: $$\frac{\Delta s}{\Delta s} = k(\frac{\Delta p}{p}) \tag{4}$$

In the formula, K is the adjustment coefficient, and for the attractive demand, K value is greater than 1; For performance demand, K is equal to 1; For basic requirements K is less than 1.

Where c is a constant, S_0 and p_0 are the current user satisfaction and current product performance, respectively, and S_r and p_r are the target values of user demand satisfaction and product performance, respectively. Further derivation can be obtained as follows:

$$S_0 = cp_0{}^k \tag{5}$$

$$S_r = cp_r{}^k \tag{6}$$

$$\frac{S_r}{S_0} = \frac{cp_r{}^k}{cp_0{}^k} = (\frac{p_r}{p_0})^k \tag{7}$$

$$k = \log_{\frac{p_r}{p_0}} (\frac{S_r}{S_0}) \tag{8}$$

The satisfaction questionnaire was measured by the KANO questionnaire with grades 1-5. The user satisfaction S_0 and the target value S_r of user satisfaction were calculated respectively:

$$S_0 = \sum_{i=1}^{n} s_{0_i} \tag{9}$$

$$S_r = \sum_{i=1}^{n} s_{r_i} \tag{10}$$

The product performance questionnaire was measured by KANO questionnaire grades 1-5. User demand p_0 and user demand target p_r are counted respectively:

$$p_0 = \sum_{i=1}^{n} p_{0_i} \tag{11}$$

$$p_r = \sum_{i=1}^{n} p_{r_i} \tag{12}$$

The logarithm of the ratio of S_0 and S_r to the ratio of p_0 and p_r is the adjustment coefficient K value.

$$k = \log_{\frac{\sum_{i=1}^{n} p_{r_i}}{\sum_{i=1}^{n} p_{o_i}}} \left[\frac{\sum_{i=1}^{n} s_{r_i}}{\sum_{i=1}^{n} s_{o_i}} \right] \tag{13}$$

2.2 Improvement coefficient under competitiveness analysis

Compare the demand importance of competitive products with that of research products. When the demand importance of research products is lower than that of competitive products, it means that their user satisfaction and market share are not as good as those of the other side. There is still a great room for improvement in product demand, and when the demand is met, user satisfaction can be greatly improved. Y_r is the target value of user demand importance of competitive products, and the value of improvement coefficient W:

$$W = K \log_M Y \tag{14}$$

The final importance of user demand Fj can be obtained by synthesizing the basic importance of user demand T_j and W_j:

$$F_j = W_j T_j \tag{15}$$

3. The importance of user comments needs to be improved under fine granularity

Based on the analysis of different user preferences and tendencies of Xiaomi's mobile user comments, a fuzzy KANO model is used for fine-grained segmentation of user needs. Finally, competitiveness analysis is introduced to solve the importance of user needs, which refines the priority order of demand importance under user comments and significantly distinguishes the difference in demand importance. This further guides enterprises to achieve maximum user satisfaction with minimal investment.

3.1 Data sets and classification

The dataset includes real user reviews of Xiaomi phones from JD APP and long texts related to mobile phone reviews obtained from Baidu Encyclopedia, Wikipedia, Xiaomi official website, Zhihu and other platforms between June and October 2023. The user comments were segmented into manual sentence marking (the author and two master's students in computer science jointly participated in the sentence marking of user comments), which was preprocessed and classified by using the method based on BTM and long text semantic enhancement. A total of 7490 user comments were obtained after three types of user comments (functional praise, functional improvement and other).

- Functional praise: Positive evaluation of the internal functions, performance, system and operation of Xiaomi mobile phones is the recognition of users' high satisfaction with all aspects of mobile phones.
- Functional improvement: Neutral or negative comments on some defects of Xiaomi mobile phones that need to be improved. It is the potential demand of users for mobile phones in all aspects.
- Other: not including the first two aspects, some other neutral and objective evaluation, such as logistics, customer service, price, etc.

3.2 Requirements mapping and fine-grained partitioning

Based on the three types of user comments obtained by classification, the LDA topic model is fitted to carry out the visual mapping of document-topic and subject-term items, extract the term items under the maximum probability topic as product features, divide them into several representative product requirements according to their attributes, and identify the relationship between subject words and user requirements through topic clustering. A three-level mapping of category-feature-demand is formed, and its document-topic probability representation is shown in Figure1. The class-feature-requirement mapping is shown in Table 1.

Table 1 Composition of requirement elements and requirement categories

Category	First-order feature	Second-order feature
Functional praise	System	Mobile phone speed(R_1)、
	function	Screen(R_2)、Pixel (R_3)、Sound(R_4)、
	Battery	Endurance(R_5)、Power consumption(R_6)、

Functional improvement	network	network outage(R_7)、signal(R_8)、
Other	Price	free of interest(R_9)、
	Service	after sale(R_{10})、

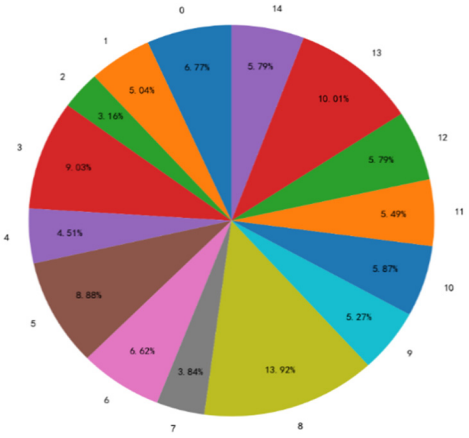

Fig 1 Others documents-topic probability distribution

The questionnaire was set up by fitting the fuzzy KANO model to the demand elements, and the 1-5 grade score was used for measurement. The average score of a certain demand element was used as the evaluation standard. The 12 types of demand elements in Table 2 are divided into high attractive demand (High A), low attractive demand (Low A), high expectation demand (High O), low expectation demand (Low O), high basic demand (High M) and low basic demand (Low M). Compared with the traditional KANO model user demand classification, as shown in Table 2, the classification is more specific.

Table 2 Comparison of KANO requirement element classification

Traditional KANO model		Fuzzy KANO Model	
Category	Element	Category	Element
A	R_1、R_4 、R_{10}	High A	R_1
		Low A	R_4 、R_{10}
M	R_2、R_3、R_7	High M	R_7
		Low M	R_2、R_3
O	R_6、R_8、R_9、R_5	High O	R_8、R_5
		Low O	R_9、R_6

Based on the classification of comments and the fine-grained division of requirements, the sparse importance of requirements is adjusted. Includes the following specific steps:

- Determine the importance of basic needs: Set up a questionnaire about the importance of basic needs. In the survey questionnaire, each requirement element is rated based on the

actual usage of the phone by the user, and the importance of basic needs is obtained by fitting the fuzzy KANO model based on the user's rating.

- Fine-grained division of user needs: Fine-grained division of user needs according to the mean value of the basic needs of each demand element.
- Calculate the adjustment factor: According to the user satisfaction questionnaire and product quality questionnaire, the adjustment coefficient K of expected demand, charm demand and basic demand was calculated by fitting function.
- Competitiveness analysis: Competitive brand and target product are introduced for competitive analysis and comparison. When the importance of user demand of the competitive product is not less than that of the target product, the pair value of the competitive product and the target value is used as the improvement coefficient to improve the adjustment coefficient.

4. experimental analysis

According to the practical application of demand importance adjustment, 10 different types of demand are selected from Table 2 to improve the demand importance coefficient. Due to the limitation of space, the steps of determining the demand importance of competitive products and determining the original importance are omitted. Demand importance before and after the improvement of competitiveness analysis is shown below.

Table 3 Traditional user demand importance adjustment

Element	KANO	Importance of basic needs	Competitive product importance	Target	Adjustment factor	Ultimate importance
R_1	A	4	4	5	1.66	6.64
R_2	M	4	4	4	1.00	4.00
R_3	M	3	4	4	1.00	3.00
R_4	A	4	4	5	1.64	6.56
R_5	O	4	4	5	1.32	5.28
R_6	O	4	4	5	1.30	5.20
R_7	M	4	4	5	1.11	4.44
R_8	O	4	4	5	1.32	5.28
R_9	O	4	4	5	1.30	5.20
R_{10}	A	4	4	5	1.64	6.56

Table 3 above shows the traditional demand importance adjustment method. On this basis, competitiveness analysis mechanism is added to improve the adjustment coefficient, and the final user demand importance is improved. The results are shown in Table 4:

Table 4 Demand importance after competitiveness analysis

Element	KANO	Importance of basic needs	Competitive product importance	Target	Improved adjustment factor	Ultimate importance
R_1	A	4	4	5	1.88	7.52
R_2	M	4	4	4	1.00	4.00
R_3	M	3	4	4	1.00	3.00
R_4	A	4	4	5	1.72	6.88
R_5	O	4	4	5	1.40	5.60
R_6	O	4	5	5	1.50	6.00
R_7	M	4	4	5	1.12	4.48
R_8	O	4	4	5	1.54	6.16
R_9	O	4	4	5	1.44	5.76
R_{10}	A	4	4	5	1.75	7.00

After adding the improvement coefficient of competitiveness analysis, the priority order of user demand importance is further refined, and the difference of demand importance is significantly differentiated. Under the traditional adjustment coefficient, the importance of R_4 and R_{10} is 6.56. The importance of R_5 and R8 were both 5.28. The importance of R_6 and R_9 are both 5.20, and the priority order of their requirement importance cannot be distinguished. After adding the competitiveness analysis, the difference of demand importance is obvious. The most important demand is R_1(high attractiveness demand), The priority of demand importance is also based on charm demand (high charm demand is greater than low charm demand), expectation demand (high expectation demand is greater than low expectation demand), and basic demand (high basic demand is greater than low basic demand), which also reflects from the side that the improvement of demand importance and the growth of user satisfaction are not simple linear relationship. The three types of user needs have a diminishing impact on improving user satisfaction. In the case that the external situation remains unchanged, enterprises should pay more attention to and understand the charismatic demand, and fully tap the charismatic demand will be more helpful to improve the competitiveness and market share of enterprises

5. Summarize

Add the competitiveness analysis to improve the importance of user needs and user satisfaction survey. In the case that the target brand's demand importance score is no lower than that of the research brand, the logarithm of the target value and the competitive brand importance is only used as the improvement coefficient to improve the adjustment coefficient under the fitting function, and the product of the combined value and the importance of the basic demand is used as the final importance of the demand. The limitation that the traditional adjustment coefficient is not highly distinguishable from the importance of demand is solved. The research shows that the demand importance scores of high attractive demand, high basic demand and high expectation demand are significantly higher, which is more worthy of enterprises and manufacturers' attention. This study provides a theoretical basis for enterprises to seize the main needs of users and improve user satisfaction.

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