# User experience measurement methods of e-commerce products based on cloud model

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**Abstract:** Traditional e-commerce product user experience measurement methods have the problems of poor measurement effect and low user experience satisfaction. This paper proposes a cloud based e-commerce product user experience measurement method. This paper uses the hierarchical structure model to build the e-commerce product user experience measurement index system to obtain the e-commerce product user experience index. Determine the proportion of indicators to complete the construction of cloud model; calculate the cloud drop expected value, expected entropy and super entropy in the cloud model, and transform the e-commerce product user experience measurement index weight coefficient into normal cloud to realise the e-commerce product user experience degree quantity. The results show the measure accuracy is about 98%, and the measurement time is less than 2 s.

**Keywords:** cloud model; e-commerce products; user experience; weight coefficient; fuzzy comprehensive metric.

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## 1 Introduction

E-commerce is that businesses provide products or services for the public through the network platform, with the help of network technology, using its own low-cost, barrier free communication and other characteristics. With its unique sales mode, e-commerce has gradually evolved from offline shopping to online shopping, which makes the shopping experience more convenient and fast, and makes users buy products that they can't buy in the past. User experience refers to the true feelings of users in the process of accepting the product. The development of e-commerce is positively correlated with user experience. If the user experience is good, e-commerce products will sell better, if the user experience is poor, it will reduce the purchase rate of such users (Hussain et al.,

2018). E-commerce website describes the product is not consistent with the actual product, there are deceptive behaviour; users find that there are quality problems when they get the goods; online sales information communication process, service is not in place; in product transportation, logistics transportation time is long; users still cannot find the required product information through the navigation information column, the website browsing effect is poor; e-commerce website setting is more popular, no innovation, lack of personalisation. These reasons are all factors that affect the user experience of e-commerce products, leading to the decrease of user experience, so e-commerce services have a certain impact on user experience (Hu et al., 2019; Joohwan et al., 2018). In order to develop the e-commerce service economy, it is necessary to measure the user experience of e-commerce products, and then obtain the user experience data in the process of network service. Therefore, the research on user experience measurement of e-commerce products has become a hot issue to be solved urgently.

Li et al. (2019) use the coefficient of variation method to measure the user experience of online game products. First, eye movement recognition technology is used to obtain the usability of game tips, and then the coefficient of variation method is used to obtain the performance differences between novices and experts. According to the differences between the two methods, the game difficulty and characteristics are extracted, and the online game product user experience measurement model is constructed. This model can improve the satisfaction of virtual electronic goods users, but there are some limitations. In Wang et al. (2018), the user experience data of Internet products were obtained in the form of user experience questionnaire. Based on the obtained data, the experience grey model was constructed, and the user experience dimension of Internet products was extracted by grey correlation analysis method, and the user experience of Internet products was measured according to the obtained experience dimension. The above two methods have achieved the measurement of user experience of e-commerce products, but the measurement accuracy is low, which leads to poor measurement effect of user experience of e-commerce products.

Chen (2018) studies the measurement method customer experience come a multi-dimensional perspective, constructs a cross-border e-commerce customer experience measurement system according to cross-border e-commerce customer data and cross-border e-commerce products, obtains the cross-border e-commerce customer experience measurement indicators from a multi-dimensional perspective, and measures customer experience with the measurement indicators of different dimensions. That effect is good, but the measurement is real-time. In Guo et al. (2018), the method of task performance was used to study the measurement method of user experience of agricultural service website, and the task performance index of agricultural service website was obtained. Based on the performance index, the user experience measurement model of agricultural service website was constructed to realise the measurement of user experience of agricultural service website. However, in the process of e-commerce product user experience, the satisfaction of user experience is low, and the measurement time of e-commerce product user experience is long, which leads to low measurement efficiency.

Based on the problems in the above methods, this paper proposes a cloud model based e-commerce product user experience measurement method. Firstly, the user experience measurement index of e-commerce products is obtained, and then the proportion of indicators by AHP. The cloud model is used to measure the user experience of e-commerce products.

**Table 1** Construction of experience measurement factors

| *Main indicators* | *Subordinate indicators* | *Third level indicators* |
|---|---|---|
| User experience of e-commerce products $U$ | Trust $U_a$ | Word of mouth $U_{a1}$ |
| | | Payment security $U_{a2}$ |
| | | Information safety $U_{a3}$ |
| | | Brand $U_{a4}$ |
| | | Consumer protection $U_{a5}$ |
| | Commodity $U_b$ | Quality $U_{b1}$ |
| | | Conformity of real object and description $U_{b2}$ |
| | | Replenishment processing $U_{b3}$ |
| | | Update frequency $U_{b4}$ |
| | | Commodity diversity $U_{b5}$ |
| | | Cost performance $U_{b6}$ |
| | Service $U_c$ | Guarantee $U_{c1}$ |
| | | Return and exchange $U_{c2}$ |
| | | Dispute resolution $U_{c3}$ |
| | | Service efficiency $U_{c4}$ |
| | | Service quality $U_{c5}$ |
| | Logistics $U_d$ | Distribution service quality $U_{d1}$ |
| | | Delivery speed $U_{d2}$ |
| | Website vision $U_e$ | Recognition degree $U_{e1}$ |
| | | Aesthetics $U_{e2}$ |
| | | Unity $U_{e3}$ |
| | Individualisation $U_f$ | Incentive mechanism $U_{f1}$ |
| | | Membership mechanism $U_{f2}$ |
| | | Customised services $U_{f3}$ |
| | | Sales promotion $U_{f4}$ |
| | | Publicity and promotion $U_{f5}$ |

## 2 E-commerce product user experience measurement method based on cloud model

### *2.1 Construction of e-commerce product user experience measurement index system*

The user experience of e-commerce products refers to the psychological thoughts of users in the process of experiencing e-commerce products and services, which cannot be concretely expressed. Information technology needs to be used to measure the user experience of e-commerce products. The experience system is composed of multiple different measurement index elements, which can be divided into multiple indicators to

reflect the experience. Therefore, the user experience measurement indicator system of e-commerce products is constructed to accurately measure the quality of experience that e-commerce products bring to users (Schladen et al., 2020). The hierarchical structure model has 3 layers, namely the target layer, the criterion layer, and the measure layer. The target layer is the first-level indicator, which is the highest layer of the hierarchy; the criterion layer is the second-level indicator, which is the 6 influence indicators of e-commerce product user experience. The measure level is a three-level indicator, which is a measure to achieve the goal (Kim et al., 2020; Puspasari et al., 2019). Therefore, this paper adopts a hierarchical structure model to construct a user experience measurement index system for e-commerce products, and obtains six indicators that affect the user experience of e-commerce products, including trust, goods, services, logistics, website vision, and personalisation. Trust is the most basic condition of e-commerce products for users. Only with trust can e-commerce transactions continue; goods are products that e-commerce users need to buy, and the quality of goods will seriously affect the user experience; service is the business responsibilities performed for users in the sales process, service quality has a certain impact on user satisfaction; logistics is that the user purchases the required goods through the e-commerce website, the merchant delivers the goods for the user, and transports it to the user by express delivery. In the address, the logistics waiting time is the logistics service experienced by users; e-commerce website vision refers to the visual experience that the website brings to users; personalisation is an extraordinary experience brought to users by unique novelty (Davidaviien et al., 2019; Jo et al., 2019; Daems and Macken, 2019).

## *2.2 Determination of weight of user experience index*

When determining the weight of each indicator, through the constructed judgment matrix, the weight coefficient of each measurement indicator is obtained, and according to the obtained weight coefficient, the analytic hierarchy process is used to calculate the relative importance of the six measurement indicators (Sajina and Orehovacki, 2018; Thielsch and Salaschek, 2020; Jamil et al., 2018). Set the scale of the metric set from 1 to 9, and construct a judgment matrix according to the meaning given by the metric set.

**Table 2** Proportional scale measurement set

| *S. No.* | *Scale* | *Meaning* |
|---|---|---|
| 1 | 1 | Indicates that two factors are equally important |
| 2 | 3 | Indicates that one factor is slightly more important than the other |
| 3 | 5 | One factor is more important than the other |
| 4 | 7 | It means that compared with two factors, one factor is obviously more important than the other |
| 5 | 9 | It means that compared with two factors, one factor is absolutely more important than the other |
| 6 | 2,4,6,8 | The median value of the above two adjacent judgments |
| 7 | 1,1/2,...,1/9 | The ratio of comparative judgment |

Analyse the measurement set in Table 2, suppose that the user experience measurement indicators of the same type of e-commerce products are a criterion layer, and compare *n* indicators $U_{m1}, U_{m2}, \ldots, U_{mn}$ in a certain layer, where $m = a, b, c, d, e, f$ . Suppose the influence of a certain e-commerce product user experience measurement index in another criterion layer is *O*, take two measurement indexes $U_i, U_j$ each time, and use $a_{ij}$ to represent the ratio of the influence of $U_i$ and $U_j$ to *O*, which forms a comparison matrix *A* for:

$$A = \begin{matrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nm} \end{matrix} \tag{1}$$

In the formula, $A = \left(a_{ij}\right)_{n \times n}, a_{ij} > 0, a_{ji} = 1 / a_{ij}, i, j = 1, 2, ..., n$ . At this time, the formula (1) is a positive and reciprocal matrix. According to the above formula, obtain the weight coefficient:

$$A\omega = \gamma\omega \tag{2}$$

In the formula, $\gamma$ represents the largest feature root of *A*, and $\omega$ represents the feature vector of $\gamma$.

Combine formula (1) and formula (2) to get the index weight value (Lo, 2019; Wong and Ghavifekr, 2018). According to the weight value obtained, the analytic hierarchy process is used to calculate the relative importance of the six metrics of trust, goods, services, logistics, website vision, and personalisation. The calculation formula is:

$$Q = \frac{c}{A\omega(U_a, U_b, U_c, U_d, U_e, U_f)} \tag{3}$$

In the formula, *c* represents the degree of influence that affects the user experience of e-commerce products.

On the basis of constructing the user experience measurement index system of e-commerce products and obtaining the user experience measurement index of e-commerce products, the weight of each metric index is determined.

## 3 Implementation of e-commerce product user experience measurement based on cloud model

The cloud model consists of three eigenvalues: expected value *Ex*, entropy *En* and super entropy *He*. The expected value *Ex* is the core of the cloud model. It is the sample mean value of user experience data of e-commerce products, representing the cloud drop that best represents the domain in the entire cloud; entropy *En* is the thickness of the cloud, that is, the degree of measurement of user experience of e-commerce products. The larger the *En*, the larger the span of the cloud, and the greater the degree of measurement; the super-entropy *He* is the cohesion of the cloud, the entropy of entropy, the size of *En* determines the size of *He*, and also determines the measurement of e-commerce product user experience The higher the super-entropy value, the more discrete the cloud droplet distribution and the thicker the cloud layer.

Suppose $M$ is a quantitative domain represented by precise numerical values, and $S$ is a qualitative concept on $M$. If the given parameter $x \in M$ is a random occurrence of the qualitative concept $S$, the certainty $S(x) \in [0,1]$ of $x$ to $S$ was a random digit $s: M \to [0,1]$, $x \in M$, then the distribution of $T$ on the universe $M$ is called a cloud, denoted as cloud $S(x)$, and each $(x, S(x))$ is called a cloud drop (Kim et al., 2018; Leng et al., 2020).

The sample mean value of user experience data of e-commerce products is calculated by $N$ cloud drop $x_i$:

$$\overline{x} = \frac{1}{N} Q \sum_{i=1}^{N} x_i \tag{4}$$

Obtain the absolute centre distance of the first-order sample according to the above formula:

$$B = \frac{1}{N} \sum_{i=1}^{N} |x_i - \overline{x}| \tag{5}$$

Then the sample variance can be expressed as:

$$s^2 = \frac{1}{N-1} \sum_{i=1}^{N} (x_i - \overline{x})^2 \tag{6}$$

Calculate the expected value, entropy and super entropy of cloud drops:

$$Ex = \overline{x} = \frac{1}{N} Q \sum_{i=1}^{N} x_i \tag{7}$$

In the formula, $Ex$ represents cloud drop expectations, $N$ represent all metrics, $Q$ represents the measurement coefficient.

$$En = \left( \frac{\pi}{2} \right)^{\frac{1}{2}} \times B \tag{8}$$

In the formula, $En$ represents the expected entropy result, $B$ represents the measure credibility factor.

$$He = \left( s^2 - En^2 \right)^{\frac{1}{2}} \tag{9}$$

where $He$ represents the hyperentropy result, $s$ represents the quantitative domain.

Transform the weight coefficients of the user experience metrics for e-commerce products obtained above into normal clouds, use different normal clouds to indicate their importance, and build a fuzzy comprehensive measurement model of the final target layer based on the three characteristic values:

$$RC = \sum_{i=1}^{N} A\omega \times S(x)(Ex, En, He) \tag{10}$$

In the formula, $RC$ represents the user experience measurement results of e-commerce products, $A\omega$ represents the bidirectional reference set matrix measure.

In the measurement of e-commerce product user experience, the relationship between the sample mean value and data of e-commerce product user experience data is obtained to complete the construction of cloud model; the cloud drop expected value, expected entropy and super entropy in cloud model are calculated to transform the weight coefficient of e-commerce product user experience measurement index into normal cloud to realise the measurement of e-commerce product user experience.

## 4 Simulation experiment analysis

### *4.1 Experimental environment*

A simulation experiment is carried out under the Matlab simulation platform.

### *4.2 Experimental data*

Taking six indicators of a Taobao product as the experimental content, including trust, goods, services, logistics, website vision and personalisation, this paper measures the user experience of e-commerce products, and randomly extracts experimental samples from the six indicators, so as to determine the effective sample data. The number of samples of each index in the experiment is shown in Table 3.

**Table 3** Number of experimental samples

| | *Sample/piece* | *Valid sample/piece* |
|---|---|---|
| Trust | 30 | 30 |
| Commodity | 75 | 70 |
| Service | 80 | 70 |
| Logistics | 120 | 100 |
| Website vision | 750 | 700 |
| Individualisation | 920 | 900 |

### *4.3 Experimental index*

Taking the number of effective experimental samples as the experimental object, this paper uses the method to test six indexes, such as trust, goods, service, logistics, website vision and personalisation, and uses contrast to test the measurement accuracy, measurement time and user experience satisfaction of the sample data. Among them, the measurement accuracy is calculated by formula (11), that is:

$$J = \frac{Y}{q} \times 100 \tag{11}$$

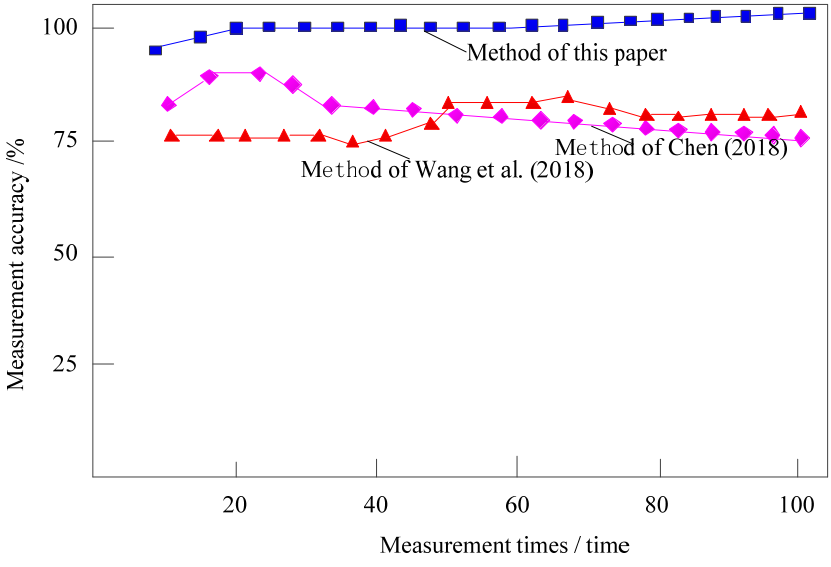
In the formula, $J$ represents measurement accuracy, $Y$ represents the number of samples measured, $q$ represents all samples of the metric.

## 4.4 Results

### 4.4.1 Measurement accuracy of user experience of e-commerce products

The accuracy of user experience measurement of sample e-commerce products by this method, Wang et al. (2018) method and Chen (2018) method is analysed.

**Figure 1** Comparison of user experience measurement accuracy of e-commerce products




By analysing the data in Figure 1, it can be seen that with the change of measurement times, there are some differences in the measurement accuracy of sample data among the methods in this paper, Wang et al. (2018) and Chen (2018). Among them, the user experience measurement accuracy of e-commerce products of this method is higher than that of the other two methods, and the highest accuracy can reach 98%, while the measurement accuracy of the other two methods fluctuates, and the highest accuracy is always lower than that of the proposed method. This is because this method determines the measurement index and weight before the measurement, which improves the pertinence of the measurement and the accuracy of the measurement.

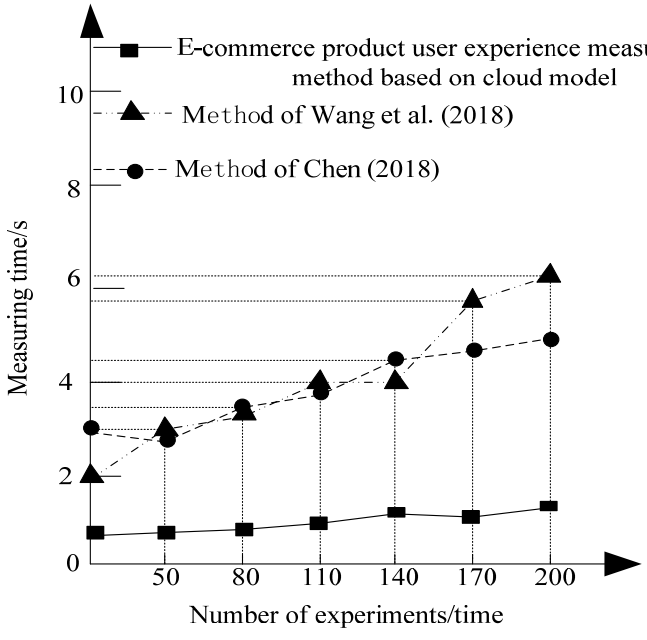
### 4.4.2 Time consuming analysis of e-commerce product user experience measurement

This paper makes a comparative analysis of the proposed e-commerce product user experience measurement method, this method in Wang et al. (2018) and the method in Chen (2018). The comparison results are shown in Figure 2.

According to Figure 2, the user experience measurement time of e-commerce products based on cloud model proposed is within 2S, while the user experience measurement time of e-commerce products based on methods of Wang et al. (2018) and Chen (2018) is within 48% and 7S and 5S, which indicates that the user experience measurement time of e-commerce products based on cloud model proposed is within 2S.

Compared with the methods of Wang et al. (2018) and Chen (2018), the measurement time of e-commerce product user experience is shorter, and the measurement efficiency of e-commerce product user experience of this method is higher. According to the teacher's opinion, more analysis is added in the analysis of experimental results.

**Figure 2** Measuring time for e-commerce product user experience

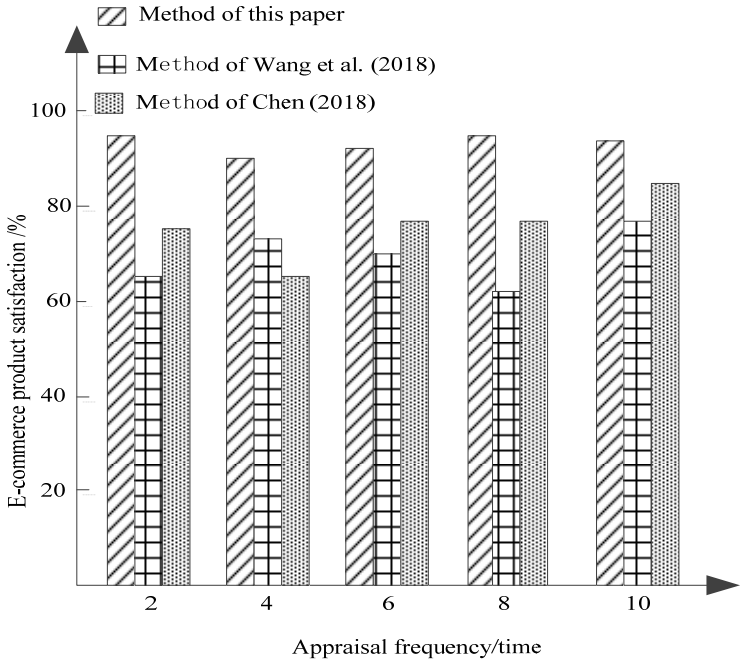



### *4.4.3 E-commerce product user experience satisfaction analysis*

Using the cloud model-based e-commerce product user experience measurement method, Wang et al. (2018) method and Chen (2018) method proposed in this paper, 30 users are tested for e-commerce product user experience satisfaction, and the test results are shown in Figure 3.

According to Figure 3, with the continuous change of evaluation times, three methods are used to evaluate the user experience satisfaction of e-commerce products. Among them, the customer satisfaction of e-commerce products of this method is high, and always higher than 90%, while the satisfaction of e-commerce products of Wang et al. (2018) and Chen (2018) is within a reasonable range, but always lower than this method. In contrast, the user experience measurement method of e-commerce products based on cloud model proposed in this paper is more popular with users.

**Figure 3** Comparison of user experience satisfaction of e-commerce products




## 5 Conclusions

User experience of e-commerce products can best reflect the quality of e-commerce services, and user experience of e-commerce products is a kind of psychological perception behaviour. In the process of accepting e-commerce services, people will be affected by some factors, which will reduce the quality of experience. Through computer science to measure the user experience of e-commerce products, lay the foundation for e-commerce economy. In order to improve the user experience of e-commerce products, and in view of the shortcomings of traditional e-commerce product user experience measurement methods. Through a construction user experience measurement index system, six measurement indexes including trust, goods, services, logistics, website vision and personalisation are obtained. Six measurement indexes of AHP are used to calculate the weight and obtain the weight coefficient. The cloud model is used to build the e-commerce product user experience measurement model, and the e-commerce product user experience measurement is realised. The simulation results show that the proposed e-commerce product user experience measurement method based on cloud model has higher measurement accuracy, higher measurement effect, shorter measurement time and improved user experience satisfaction. Compared with traditional methods, this method has the following advantages:

1 Using this method, the user experience measurement accuracy of e-commerce products can reach up to 98%, which has a certain reliability.

2 It is feasible to use this method to improve the user experience satisfaction of e-commerce products.

3 Using this method to measure the user experience of e-commerce products takes less time than 2 seconds, and the measurement is faster.

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