Research on Customer Perception Value of Delivery O2O Platform Based on PCA-FUZZY

Jiali Zhao

School of Management, China University of Mining and Technology, Beijing, Beijing 100083, China.

1091909238@qq.com

Abstract. In order to scientifically measure the customer perceived value (CPV) of the Online to Offline (O2O) platform, the CPV indicator system of the delivery O2O platform is constructed from three dimensions which are functional value, service value, and experience value. The various dimensions and indicators are weighted by the principal component analysis (PCA). A fuzzy comprehensive evaluation model of CPV for delivery O2O Platform is constructed. Taking the M platform as an example, it is found that the M platform should focus on the enhancement of customer experience value while maintaining functional value and service value.

1. Introduction

The delivery O2O platforms have a high frequency of user consumption and their competition is fierce in China. It is an urgent problem for delivery O2O platforms to improve customers' satisfaction and loyalty. Therefore, how to increase customers' willingness to use a delivery platform is a valuable issue to be resolved. Clearly, CPV has a significant impact on the customer satisfaction and repeated purchases [1]. It can be seen that the CPV is an important factor to maintain the O2O platform's competitiveness. However, how to measure the CPV of the O2O platform?

In this paper, a fuzzy comprehensive evaluation model based on CPV indicator system and PCA method is proposed to solve this problem. Furthermore, taking M platform as an example, the data of CPV is obtained through a questionnaire survey. After a series of calculation, the advantages and disadvantages of M platform can be obtained. Finally, some management improvement suggestions are summarized.

2. The Construction of Indicator System

There are substantial research results for CPV, and in the context of the continuous development of the Internet, many works have researched CPV dimensions for online shopping. Eun-Ju and Jeffrey [3] believed that the CPV under the context of online shopping should be divided into experience value and economic value; Gao Juan et al[4] divided CPV into perceived gains and perceived gains and losses; Gao Yingzhi [5] divided CPV of online restaurant group purchase into three dimensions: economic value, quality value and convenience value; Liu Hongguo [6] divided the CPV of O2O catering platform into four dimensions: result value, procedural value, emotional value, and social value. In summary, according to a comprehensive consideration of predecessors' research, we divide the CPV of the delivery O2O platform into three dimensions: functional value, service value and experience value. There are several measurement items in each dimension as shown in Table 1.

3. Investigation

M platform is taken as research object, and questionnaires are conducted through on-site or online investigation. The validity of the pre-test questionnaire is convincing, followed by a large sample of formal investigations. Finally, 713 valid questionnaires are returned, and the effective rate of the questionnaire is 94.44%.

Table 1. Indicator system of CPV for delivery O2O platform

Target layer	Criteria layer	Indicator layer	Items
Indicator System of CPV for Delivery O2O Platform	Functional Value	Food Safety	The food is safe and reliable
		Food Category	The platform is rich in food
		Food Temperature	It has good food insulation/cooling effect
		Prices	It has reasonably priced
		Website Performance	The process is easy and convenient to operate
		Interface Design	The interface is beautiful
	Service Value	Special Service	The distinctive service is attractive
		Service	It has a good after-sales service
		Delivery Attitude	The rider has a good attitude
		Delivery Time	Food can always be delivered on time
	Experience Value	Emotional Value	It can makes me happy and relaxed
		Time Value	Booking on this platform saves my time
		Social Value	It can reflect my personality
		Safety Value	The transaction process is safe
		Green Value	The food packaging is environmentally friendly

In order to ensure the validity and accuracy of the scale and data, SPSS21.0 is used to test the reliability and validity, as shown in Table 2.

Table 2. Reliability and Validity Test Results

	Dimensions	Number of items	Cronbach's Alpha	Cronbach's Alpha	KMO	Bartlett's sphere test		
						Chi-square	df	Sig.
CPV for Delivery O2O Platform	Functional value	6	0.896					
	Service value	4	0.908	0.873	0.910	7371.950	105	0.000
	Experience value	5	0.913					

4. Analysis

4.1 Building Fuzzy Comprehensive Evaluation Factor Set

The set of target layer is as follows:

$$U = (U1, U2, U3)$$

The set of criteria layers is as follows:

$$U1 = (U11, U12, U13, U14, U15, U16)$$
$$U2 = (U21, U22, U23, U24)$$
$$U3 = (U31, U32, U33, U34, U35)$$

4.2 Determination of Rating Set

The evaluation set of the CPV is set V, and the evaluation level is divided into five levels. The larger the number, the better the evaluation.

$$V = (V1, V2, V3, V4, V5)$$

The evaluation set X is quantified and normalized using the formula $y_i = \frac{m_i - m_{min}}{m_{max} - m_{min}}$ (m_i indicates the evaluation level), and the quantified set is obtained as follows:

$$Y = (y_1, y_2, y_3, y_4, y_5) = (0, 0.25, 0.5, 0.75, 1)$$

The evaluation results of CPV is shown in Table 3.

Table 3. Evaluation Table of CPV

			V1	V2	V3	V4	V5
CPV U	Functional value U1	Food Category U11	5.2	13.5	28.1	37	16.3
		Food Safety U12	5	15.1	28.9	34.4	16.5
		Food Temperature U13	6.6	14.4	27.6	35.2	16.1
		Food prices U14	9.8	14.9	25.1	30.4	19.8
		Website Performance U15	6.7	13.5	27.3	35.9	16.5
		Interface design U16	9	1.8	12.8	34.9	41.5
	Service value U2	Featured Service U21	1.1	5.2	17.8	41.8	34.1
		After-sales service U22	1.5	6.9	19.1	45.2	27.3
		Delivery attitude U23	2.2	6.2	18.4	40.3	33
		Delivery time U24	2.4	4.8	17.1	40.1	35.6
	Experience value U3	Emotional value U31	2.5	19.4	45.9	23.3	9
		Time value U32	5	20.2	45.3	23.3	6.2
		Safety value U33	2.4	17.1	48.8	22	9.7
		Social Value U34	4.8	18.7	48.4	22.2	6
		Green Value U35	2.2	14.4	39.1	29.9	14.3

4.3 Determine the Weight Set of the Evaluation Indicator System

PCA is used to determine the weights. The indicators' weights of target layer are calculated through the variance contribution rate. After the normalization, the sets of weights as follows:

$$w = (w_1, w_2, w_3) = (0.3652, 0.3469, 0.2879)$$

Then the weights of the criteria layer indicators are obtained by using the maximum variance method rotation factor load. After the normalization, their weights are set as follows:

$$w_1 = (w_{11}, w_{12}, w_{13}, w_{14}, w_{15}, w_{16})$$
$$= (0.1773, 0.1754, 0.1722, 0.1708, 0.1695, 0.1348)$$
$$w_2 = (w_{21}, w_{22}, w_{23}, w_{24})$$
$$= (0.2615, 0.2523, 0.2456, 0.2405)$$
$$w_3 = (w_{31}, w_{32}, w_{33}, w_{34}, w_{35})$$
$$= (0.2119, 0.2055, 0.2005, 0.2001, 0.1819)$$

4.4 The Determination of the Judgement Membership Matrix

According to the scores of CPV, the membership matrices R_1, R_2, R_3 are constructed by three factors: functional value, service value, and experience value. U_{ij} (the j-th sub-factor in the i-th main factor) represents the k-th grade for the evaluation, which is denoted as the membership degree r_{ijk}:

$$r_{ijv} = v_{jk} \Big/ \sum_{k=1}^{5} v_{jk} \quad (i = 1,2,3; j = 1,2 \cdots n; k = 1,2 \cdots 5)$$

Membership degree matrices are represented as follows:

$$R_1 = \begin{bmatrix} 0.163 & 0.370 & 0.281 & 0.135 & 0.052 \\ 0.165 & 0.344 & 0.289 & 0.151 & 0.050 \\ 0.161 & 0.352 & 0.276 & 0.144 & 0.066 \\ 0.198 & 0.304 & 0.251 & 0.149 & 0.098 \\ 0.165 & 0.359 & 0.273 & 0.135 & 0.067 \\ 0.415 & 0.349 & 0.128 & 0.018 & 0.090 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0.341 & 0.418 & 0.178 & 0.052 & 0.011 \\ 0.273 & 0.452 & 0.191 & 0.069 & 0.015 \\ 0.330 & 0.403 & 0.184 & 0.062 & 0.022 \\ 0.356 & 0.401 & 0.171 & 0.048 & 0.024 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} 0.090 & 0.233 & 0.459 & 0.194 & 0.025 \\ 0.062 & 0.233 & 0.453 & 0.202 & 0.050 \\ 0.097 & 0.220 & 0.488 & 0.171 & 0.024 \\ 0.060 & 0.222 & 0.484 & 0.187 & 0.048 \\ 0.143 & 0.299 & 0.391 & 0.144 & 0.022 \end{bmatrix}$$

4.5 Fuzzy Comprehensive Evaluation

First fuzzy comprehensive evaluation set $B_i (i = 1,2,3)$ of the criterion layer is calculated as:

$$B_i = R_i \cdot W_i (i = 1,2,3).$$

The comprehensive model $B_i (i = 1,2,3)$ is computed according to the general matrix comprehensive multiplication algorithm, and the results are formulated as

$$B_1 = W_1 \cdot R_1 = (0.203, 0.346, 0.254, 0.126, 0.070)$$
$$B_2 = W_2 \cdot R_2 = (0.325, 0.419, 0.181, 0.058, 0.018)$$
$$B_3 = W_3 \cdot R_3 = (0.089, 0.240, 0.456, 0.181, 0.034)$$

Based on the principle of maximum degree of membership, it can be seen that function value, service value, and experience value of M platform are at the levels of "relatively high", "relatively high", and "average", respectively.

The comprehensive evaluation set of the target layer is shown in the following formula.

$$B = W \cdot R = (0.3652, 0.3469, 0.2879) \cdot [B_1, B_2, B_3]^T = (0.213, 0.341, 0.287, 0.118, 0.0415)$$

According to the fuzzy distribution method, the percentages of "very high, relatively high, average, relatively low, and very low" are: 21.3%, 34.1%, 28.7%, 11.8%, and 4.15%, respectively. According to the principle of maximum degree of membership, the comprehensive evaluation of perceived value is at the level of "relatively high" for M platform.

According to the percentage system, the comprehensive score of CPV can be quantified as

$$Z = Y \cdot B^T * 100 = 100 * \sum_{i=1}^{5} y_i \cdot b_i = 64.175$$

It can be seen that the CPV of M platform in the comprehensive customer evaluation is "relatively high".

5. Analysis

If a score of 60 is considered as a qualifying standard, then the M platform is qualified. In its three dimensions: functional values and service values meet standards, but experience values do not. From the perspective of weights, they are 0.3652, 0.3469, and 0.2879 for function value, service value, and experience value respectively. It can be seen that the most important dimension for the customer is the functional value, followed by the service value, and finally the experience value. However, the weight of experience value reaches 28.79%, which is also an important part of CPV. By comprehensively measuring the weights and scoring results, we can conclude that M platform needs to focus on the enhancement of the customer experience value while the maintaining functional value and service value.

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