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Research on E-commerce Logistic Satisfaction Based on TOPSIS Method

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ABSTRACT. *By selecting the representative e-commerce enterprises as samples, combined with the domestic and foreign agricultural e-commerce quality research results, the paper constructs consumer satisfaction evaluation index of agricultural products e-commerce. AHP method and entropy weight method are utilized to calculate the combination weight of each index. Together with the TOPSIS method, the evaluation model of agricultural products e-commerce is designed. Through the empirical analysis, it finds that JD fresh platform satisfaction evaluation is the highest, and Womai.com satisfaction evaluation is the lowest.*

KEYWORDS: *TOPSIS Method, AHP, Entropy, E-commerce, Satisfaction Evaluation.*

1. Introduction

In recent years, it is very popular for buying goods on e-commerce platform among internet users. There are some significant characteristics of e-commerce, such as impulsiveness, randomness, the pursuit of convenience and benefits. In addition, it also has the characteristics of dispersion and distribution of customers. Agricultural products e-commerce has become a new consumer channel, and gradually become a way of life. As a new thing, consumers choose e-commerce channels to buy agricultural products has not yet universal, its utilization rate is far lower than the traditional marketing channels such as farmers' markets, supermarkets and so on. It is of great theoretical and practical significance to explore the factors that affect consumers' choice of e-commerce channel to purchase agricultural products, and to grasp the consumer satisfaction evaluation of agricultural products. As a psychological concept, "satisfaction" expresses a feeling of self or state of mind, which is very vague. How to evaluate the satisfaction of agricultural products e-commerce is an urgent problem to be solved.

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2. Research Summary

In e-commerce service quality and customer satisfaction, many scholars carried out some research, individual scholars research this item from the perspective of the development of agricultural products e-commerce, liking the direct and indirect factors that affect the growth of agricultural products e-commerce [1]. There are several research from the factors affecting the purchase channels of agricultural products, and the study of consumer consumption evaluation is carried out. The factors that influence the decision of consumers to buy agricultural products are as follow: quality, price, place of origin, advertisement and salesperson introduction [2]. The richness of agricultural products, cleanliness, safety, quality who expect to buy, also become the main factors affecting consumers' choice of sales channels [3-4]. Price and economic factors have also become the main factors affecting consumers to choose agricultural products purchasing channels [5]. Consumption habits and prices are important factors affecting consumers to choose agricultural products purchase channels [6].

There are many factors affecting consumers' satisfaction of agricultural products, which are stochastic and fuzzy. The combination of AHP and entropy weight method can avoid the incomplete nature of subjective empowerment or objective empowerment. Combining the TOPSIS method to construct agricultural products consumers' satisfaction evaluation model, it can realize the systematization and mathematics of fuzzy problems, quantify the qualitative problems, and realize the comprehensive and objective evaluation of consumers' satisfaction. Through empirical research, the rationality and validity of the evaluation index and model can be verified.

3. Evaluation Indexes and Research Methods

3.1 Evaluation indexes

When shopping online, price, convenience, safety and other factors affect customer behavior and evaluation at all times. Service quality is one of the most important factors affecting customer satisfaction [7]. In terms of factors affecting consumers' choice of agricultural products e-commerce, scholars are mainly from technology, institutional environment, business model, product characteristics, trust mechanisms and other aspect. The consumer behavior model of e-commerce is constructed by integrating consumer characteristics, environmental characteristics, product / service characteristics, business and intermediary features, as well as e-commerce system (payment and logistics, website characteristics, customer service, etc.) [8-9]. Product safety, quality expectation, and information richness of website significantly influence consumers' purchase intention [10]. Online shopping perception and evaluation have significant positive effects on consumers' choice of agricultural products' e-commerce to purchase agricultural products, and family income has a significant negative impact on it [11].

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The customer satisfaction evaluation index of agricultural products e-commerce is summed up as four first level indexes: consumption cost (X_1), service complaint (X_2), product quality (X_3) and channel efficiency (X_4). Among them, consumption cost and service complaint are a cost type index, the smaller, the better. product quality and channel efficiency belong to the benefit index, the bigger, the better. Through the refinement of the first level indicators, two levels of indicators were constructed, and the two indicators were divided into cost indicators and efficiency indicators, and then a more complete customer satisfaction evaluation index of agricultural products e-commerce was constructed. Among them, consumption cost (X_1) = {product purchase cost (x_1), product purchase time (x_2), product logistics cost (x_3), Product logistics time (x_4)}. Service complaint (X_2) = {complaint quantity (x_5), complaint frequency (x_6)}. Product quality (X_3) = {product integrity (x_7), product taste (x_8), service quality (x_9), logistics quality (x_{10})}. Channel efficiency (X_4) = {platform operation efficiency (x_{11}), product supply efficiency (x_{12}), order effect efficiency (x_{13})}.

3.2 Research methods

AHP method is a quantitative method for qualitative problems. The basic idea is a complex problem into several combinations of factors, and these factors according to their dominant relationship, grouping constitute a hierarchical structure, determine the relative importance of the factors in the hierarchy by two-two methods comparison, structure comparison decision matrix, expert grading method to measure the value of a certain. The consistency test of decision matrix is carried out, and the weight ej of each index is obtained.

Entropy is a concept of physics and a measure of the degree of disorder of a system. The smaller the information entropy of an index, the greater the degree of variation of its index value, the greater the amount of information provided, the greater the weight of the index. On the contrary, the smaller the index weight is. Entropy weight method is an objective weighting method.

The entropy of index j is defined as "entropy":

$$H_j = -K * \sum_{i=1}^{m} y_{ij} * ln\, y_{ij} \text{ (j=1,2,…,n)} \quad (1)$$

Among it, $K = \frac{1}{ln\, n}$

The difference degree of index j is:

$$h_j = 1 - H_j \quad (2)$$

Make wj as the index weight of item j, and it is the following:

$$w_j = \frac{h_j}{\sum_{j=1}^{n} h_j} \quad (3)$$

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Combining the subjective weight obtained by the AHP method and the objective weight obtained by the entropy weight method, the comprehensive entropy combination weight of each index is obtained, which is:

$$\theta_j = \frac{w_j * e_j}{\sum_{j=q}^{n} w_j * e_j} \quad (j=1,2,\ldots,n) \qquad (4)$$

4. Constructing evaluation model

4.1 Hierarchy chart of evaluation index

According to the analytic hierarchy process (AHP), the X is defined as the "consumer satisfaction evaluation of e-commerce platform for agricultural products ", which break down into 3 levels (as shown in Fig.1.), liking $X=\{X_1, X_2, X_3, X_4\}$. Among them, $X_1=\{x_1, x_2, x_3, x_4\}$, $X_2=\{x_5, x_6\}$, $X_3=\{x_7, x_8, x_9, x_{10}\}$, $X_4=\{x_{11}, x_{12}, x_{13}\}$, xi as evaluation index (i=1,2,... ,13).

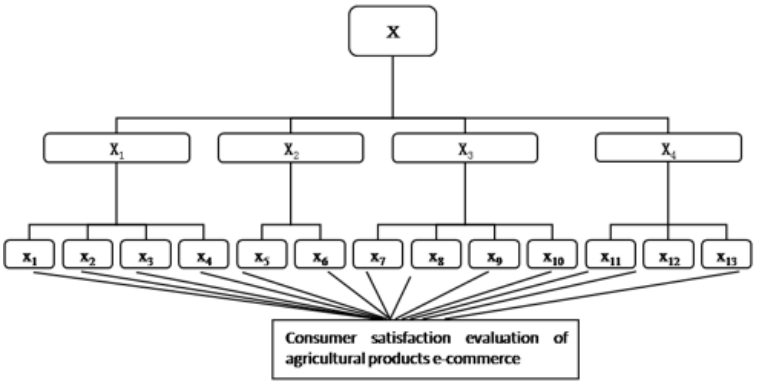

Fig.1. Hierarchical Chart of Consumer Satisfaction Evaluation of E-commerce Platform for Agricultural products

4.2 Constructing evaluation model

TOPSIS is a statistical method, which uses the ideal solution of the multi-attribute problem and the negative ideal solution to sort the alternatives. Firstly, an ideal point is determined, and the closest scheme is taken as the optimal scheme, which reduces the uncertainty of the evaluation result due to the change of the different or preferences of the evaluators. The basic idea is as follows:

4.2.1 Initial decision matrix of structure

The decision matrix X of each sample's electricity supplier can be expressed as:

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$$X = \begin{vmatrix} x_{11} & \cdots & x_{in} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{vmatrix}_{m*n}$$

In the form, m is the number of sample e-commerce, and n is the evaluation index quantity. x_{ij} represents the evaluation value of the j index of the i sample of the e-commerce. Because the selected indexes are different in dimension, it is necessary to normalize the initial data, which is the following:

$$Y_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (5)$$

Thus the standard decision matrix is obtained, which is $Y = |Y_{ij}|_{m*n}$

4.2.2 Weight of calculation index

The subjective weights are calculated by AHP method, and the objective weights are determined by the entropy weight method. The weights of the indexes are determined by the entropy weight method. The composite entropy combination weight of the index is the following:

$\theta_j = \frac{w_j * e_j}{\sum_{j=1}^{n} w_j * e_j}$, (j=1, 2, ……, n)

4.2.3Construction of weighted norm decision matrix

Let the weighted matrix be V, then:

$V = |V_{ij}|_{m*n} = Y_{ij} * \theta_j$, (i=1, 2, …, m; j=1, 2, …,n) (6)

4.2.4 Determine the ideal solution and the negative ideal solution

Let the ideal solution be V^+, and let the negative ideal solution be V^-. The set of ideal solutions is represented as the following:

V^+= {max v_{ij}, when it is collection of benefit indicators; min v_{ij}, when it is collection of cost type indicators}. Among then, i=1, 2, …, m; j=1,2, …, n (7)

The set of negative ideal solution is represented as the following:

V^-= {min v_{ij}, when it is collection of benefit indicators; max v_{ij}, when it is collection of cost type indicators}. Among then, i=1, 2, …, m; j=1,2, …, n (8)

4.2.5 Distance between sample and the ideal solution and the negative ideal solution

Distance between the sample and the ideal solution is:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \quad (9)$$

Distance between the sample and the negative ideal solution is:

$$D_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \quad (10)$$

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4.2.6 Relative relative degree of determination

The relative closeness between the evaluation value of the sample and the ideal solution and the negative ideal solution is:

$$C_i = \frac{D_i^-}{D_i^- + D_i^+}, \text{ i=1, …, m} \quad (11)$$

5. Calculation example

5.1 Initial decision matrix

Taking Tmall fresh, Womai.com, JD fresh, sfbest, YHD. com for the sample, named B_1, B_2, B_3, B_4, B_5. In the second level index, according to the qualitative indicators, 10 experts were scored, and then the average score was scored. According to the quantitative index, the data were collected from 10 statistical points in the sample, and then the average number was collected to obtain the quantitative index data. Then, the initial decision matrix is constructed, and the initial decision matrix is normalized according to the formula (5), and the standard decision matrix is obtained, as shown in table 1.

Table 1. Standard Decision Matrix

Second level index	B_1	B_2	B_3	B_4	B_5
x_1	0.015	0.022	0.021	0.020	0.025
x_2	0.042	0.055	0.038	0.044	0.051
x_3	0.033	0.035	0.023	0.027	0.028
x_4	0.063	0.075	0.051	0.042	0.053
x_5	0.167	0.160	0.112	0.213	0.226
x_6	0.135	0.211	0.104	0.078	0.112
x_7	0.094	0.060	0.123	0.104	0.086
x_8	0.091	0.083	0.124	0.122	0.106
x_9	0.093	0.086	0.127	0.101	0.082
x_{10}	0.093	0.077	0.112	0.103	0.106
x_{11}	0.121	0.108	0.114	0.091	0.085
x_{12}	0.011	0.015	0.012	0.013	0.009
x_{13}	0.016	0.013	0.018	0.012	0.014

In the table, m=1, 2, ……,5; n=1, 2, ……,13.

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5.2 Determine the weight of each index

5.2.1 Determine subjective weight

10 experts uses the method of Saaty to compare with the relative importance of the first level index, then compare the second level index. The consistency test was carried out, thus the subjective weight of each index was obtained. For example, the first level index weight and consistency test table are shown in table 2.

Table 2. Weight and Consistency Test of First Level Index

First level index	X_1	X_2	X_3	X_4	e_j	Consistency test
X_1	1.0000	1.1691	1.2963	1.0507	0.2787	λmax=4.0007 C.I=0.00021 C.R=0.0021<0.1
X_2	0.8556	1.0000	1.1102	0.8897	0.2411	
X_3	0.7720	0.9011	1.0000	0.8203	0.2145	
X_4	0.9522	1.1131	1.2334	1.0000	0.2657	

By using the same method, we can get the weight of the second level indexes of consumption cost (X_1), service complaint (X_2), product quality (X_3) and channel efficiency (X_4), liking the following:

$$X_1 = (s_{11} \quad s_{12} \quad s_{13} \quad s_{14})^T = (0.2004 \quad 0.2605 \quad 0.2738 \quad 0.2653)^T * 0.2787 = (0.0559 \quad 0.0726 \quad 0.0763 \quad 0.0739)^T$$

$$X_2 = (s_{21} \quad s_{22})^T = (0.5247 \quad 0.4753)^T * 0.2411 = (0.1265 \quad 0.1146)^T X_3 = (s_{31} \quad s_{32} \quad s_{33} \quad s_{34})^T = (0.1532 \quad 0.2618 \quad 0.3106 \quad 0.2744)^T * 0.2145 = (0.0329 \quad 0.0561 \quad 0.0666 \quad 0.0589)^T$$

$$X_4 = (s_{41} \quad s_{42} \quad s_{43})^T = (0.3689 \quad 0.3363 \quad 0.2948)^T * 0.2657 = (0.0980 \quad 0.0894 \quad 0.0783)^T$$

5.2.2 Determine objective weight

According to the standard decision matrix constructed, the formula (1)-(3) can be obtained: n=13, $K = \frac{1}{ln\,13} = 0.3899$, and then the objective weight of each index is obtained, as shown in table 3.

Table 3. Objective Weights of Second Levels Index of Sample

Index	B_1	B_2	B_3	B_4	B_5	w_j
x_1	0.015	0.022	0.021	0.02	0.025	0.0571
x_2	0.042	0.055	0.038	0.044	0.051	0.0697
x_3	0.033	0.035	0.023	0.027	0.028	0.0618

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x_4	0.063	0.075	0.051	0.042	0.053	0.0739
x_5	0.167	0.16	0.112	0.213	0.226	0.1022
x_6	0.135	0.211	0.104	0.078	0.112	0.0930
x_7	0.094	0.06	0.123	0.104	0.086	0.0856
x_8	0.091	0.083	0.124	0.122	0.106	0.0889
x_9	0.093	0.086	0.127	0.101	0.082	0.0870
x_{10}	0.093	0.077	0.112	0.103	0.106	0.0872
x_{11}	0.121	0.108	0.114	0.091	0.085	0.0886
x_{12}	0.011	0.015	0.012	0.013	0.009	0.0516
x_{13}	0.016	0.013	0.018	0.012	0.014	0.0534

5.2.3 Determine combination weight

According to formula (4), the entropy combination weight of each index is calculated, as shown in table 4.

Table 4. Entropy Combination Weight of Each Index

Index	e_j	w_j	θ_j
x_1	0.0559	0.0571	0.0408
x_2	0.0726	0.0697	0.0646
x_3	0.0763	0.0618	0.0603
x_4	0.0739	0.0739	0.0698
x_5	0.1265	0.1022	0.1653
x_6	0.1146	0.0930	0.1363
x_7	0.0329	0.0856	0.0360
x_8	0.0561	0.0889	0.0637
x_9	0.0666	0.0870	0.0741
x_{10}	0.0589	0.0872	0.0657
x_{11}	0.0980	0.0886	0.1110
x_{12}	0.0894	0.0516	0.0590
x_{13}	0.0783	0.0534	0.0534

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5.3 Construct weighted norm decision matrix, and determine ideal solution and negative ideal solution

Table 4. Weighted Norm Decision Matrix and Ideal Solution and Negative Ideal Solution

Index	B_1	B_2	B_3	B_4	B_5	V^+	V^-
x_1	0.0006	0.0009	0.0009	0.0008	0.0010	0.0006	0.0010
x_2	0.0027	0.0036	0.0025	0.0028	0.0033	0.0025	0.0036
x_3	0.0020	0.0021	0.0014	0.0016	0.0017	0.0014	0.0021
x_4	0.0044	0.0052	0.0036	0.0029	0.0037	0.0029	0.0052
x_5	0.0276	0.0264	0.0185	0.0352	0.0374	0.0185	0.0374
x_6	0.0184	0.0288	0.0142	0.0106	0.0153	0.0106	0.0288
x_7	0.0034	0.0022	0.0044	0.0037	0.0031	0.0044	0.0022
x_8	0.0058	0.0053	0.0079	0.0078	0.0068	0.0079	0.0053
x_9	0.0069	0.0064	0.0094	0.0075	0.0061	0.0094	0.0061
x_{10}	0.0061	0.0051	0.0074	0.0068	0.0070	0.0074	0.0051
x_{11}	0.0134	0.0120	0.0127	0.0101	0.0094	0.0134	0.0094
x_{12}	0.0006	0.0009	0.0007	0.0008	0.0005	0.0009	0.0005
x_{13}	0.0009	0.0007	0.0010	0.0006	0.0007	0.0010	0.0006

According to the formula (6)-(8), the weighted norm decision matrix is calculated, and the ideal solution and the negative ideal solution of each index are calculated, as shown in table 5.

5.4 Distance between the calculated sample and the ideal solution and the negative ideal solution

According to formulas (9) and (10), the distances between the ideal solutions and the negative ideal solutions are calculated respectively, as the following:

$D_1^+ = 0.0126, D_1^- = 0.0150$;

$D_2^+ = 0.0207, D_2^- = 0.0113$;

$D_3^+ = 0.0037, D_3^- = 0.0248$;

$D_4^+ = 0.0172, D_4^- = 0.0188$;

$D_5^+ = 0.0202, D_5^- = 0.0139$.

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5.5 Determine relative relative degree

According to the formula (11), the relative closeness of each sample to the ideal solution and the negative ideal solution is calculated respectively, as the following:

C_1=0.5428, C_2=0.3524, C_3=0.8693, C_4=0.5230, C_5=0.4066

6. Conclusions and Discussions

According to the relative closeness of the TOPSIS method, the closer the sample to the ideal scheme, the higher the satisfaction of the consumer evaluation. Thus the customer satisfaction ranking of the selected samples is obtained, that is $C_3 > C_1 > C_4 > C_5 > C_2$. Visible, C_3 highest, that is, JD fresh consumer satisfaction evaluation is the highest; C_2 minimum, that is, Womai.com consumer satisfaction evaluation is the lowest.

JD fresh is proprietary agricultural products e-commerce platform, proprietary business enterprise need to fully participate in the goods in the whole supply chain, including the sale of goods selection, supplier development and negotiation, business platform operation, and deeply involved in logistics, customer service and customer service and other service sectors. JD fresh belongs to the comprehensive e-commerce platform JD mall, which has a very high consumption flow. JD mall has a higher advantage in agricultural products quality control, customer management, after-sales service. In addition, JD fresh rely on JD self built logistics resources advantages, can effectively enhance the use of logistics evaluation of consumers. In the realization of the expected sales goals, it but also enhance customer satisfaction evaluation, and achieve the quality of service and logistics satisfaction industry-leading advantages.

Womai.com belongs to the COFCO group, is a typical vertical e-commerce platform, focusing on agricultural electricity supplier sales. Due to the type of products that Womai.com is relatively single, the user group is weaker than the integrated electronic business platform, while the website traffic is less, the lack of effective market development potential. Womai.com’s market positioning is niche market, determines the commodity category of a single, and affected by the policy factors.

Vertical e-commerce platform are weak in scale, strength, flow and management level. Womai.com uses the third party logistics to achieve product transportation and distribution. Consumers' satisfaction evaluation will be affected by the quality of service of the third party logistics. Its risk, control is low, and the cost is higher, which leads to the lowest evaluation of consumers.

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